Vol. 91, No. 13 New York, March 31, 1928 *Pages 643-692*

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Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician

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McGRAW-HILL PUBLISHING COMPANY, INC., Tenth Ave. at 36th St., NEW YORK, N. Y.

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NEW YORK District Office, 285 Madison Ave.
WASHINGTON, National Press Building
CHICAGO, 7 South Dearborn St.
PHILADELPHIA, 1600 Arch St.
CLEVELAND, Guardian Building
ST. LOUIS, Bell Telephone Building
SAN FRANCISCO, 883 Mission Street
LONDON, 6 Bouverie Street, London E. C. 4

Cable Address "Machinist, N. Y."

Publishers of
Engineering News-Record — American Machinist
Power — Chemical and Metallurgical Engineering
Coal Age — Engineering and Mining Journal
Electrical Merchandising
Ingeniería Internacional — Electric Railway Journal
Bus Transportation — Construction Methods
Electrical World — Radio Retailing
Electrical West
(Published in San Francisco)
American Machinist—European Edition
(Published in London)

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.
Circulation of this issue, 19,500

The annual subscription rate is $5 in the United States, Canada, Mexico, Alaska, Hawaii, Philippines, Porto Rico, Canal Zone, Honduras, Cuba, Nicaragua, Peru, Colombia, Bolivia, Dominican Republic, Panama, El Salvador, Argentina, Brazil, Spain, Uruguay, Costa Rica, Ecuador, Guatemala, Haiti and Paraguay. Extra foreign postage, $4 (total $9 or 38 shillings). Subscriptions may be sent to the New York office or to the London office. Single copies, postage prepaid to any part of the world, 25 cents.
Change of Address—When change of address is ordered the *new* and the *old* address must be given. Notice must be received at least ten days before the change takes place.

Copyright, 1928, by McGraw-Hill Publishing Company, Inc.

Published weekly

Entered as second-class matter Jan. 20, 1907, at the Post Office at New York, N. Y., under the Act of March 3, 1879.
Printed in U. S. A.

Advertising Index—Alphabetical, 90; Classified, 84, 86, 88; Directory of Engineers, 42, 43; Searchlight Section, 44-49

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Electrical World

Published by McGraw-Hill Publishing Company, Inc.
W. H. ONKEN, JR.
Editor

VOLUME 91 — *New York, Saturday, March 31, 1928* — NUMBER 13

Unemployment Alarmists Are Belied by Facts

FIGURES for unemployment in this country, freely bandied about, have attained a size that seems to have no basis other than that of political propaganda. The reliable available data show that the published unemployment figures for the country as a whole are in considerable part based on conditions of a seasonal or regional character. The energy consumption of about three thousand manufacturing plants throughout the nation, compiled by the ELECTRICAL WORLD, shows that the rate of production during February was about 16.2 per cent over December. This is slightly under the the rate reported for the same period of 1927, but considerably over the rate of increase reported for the same month in 1924, 1925 or 1926. In the electrical industry there is a distinct feeling of optimism as to the trend in business, particularly since the first of March.

To show further how far wrong current figures of unemployment are there may be cited the conditions in Baltimore, which recently was chosen by the Department of Commerce as a test city for determining actual employment conditions. Some opinions placed the number of unemployed in Baltimore at 70,000, and a careful estimate made by the Chamber of Commerce in conjunction with the various labor organizations set the figure at 60,000. An actual census made by the Department of Commerce gave the true figure as only 17,000, showing that the previous totals were hopelessly inaccurate. Unemployment figures are valuable to the executive as an aid in guiding his business. Unless they can be shown to be based on fact they should be cast aside as worthless.

* * * *

Indoor or Outdoor Domestic Metering

AN ALMOST unanimous opinion and requirement on the part of electric light and power companies relegates the domestic meter to the dark inaccessibility of the far corners of the consumer's cellar. No hazard of life or limb is unknown in the multitudinous stretches between the back door and the entrance switch. Metermen must, in some cases, call many times before a reading can be obtained. Calibration tests are delayed and interminably postponed through failure to gain an entrance. Meters cannot be set or removed when desired. It is another item in the long roll of lost hours, labor and money. Is it necessary?

The large number of summer homes within its territory and a racial dislike on the part of local housewives to the tramping of muddy shoes across spotless and inviolate kitchen floors led a well-managed utility to consider the advisability of outdoor metering. Commercial and operating men agreed that it could be done if the increased cost of protective equipment were minimized. The result was the development of a zinc-aluminum case for back-porch or shed mounting, the inclosed meter being read through a glassed port. Service is brought directly from the pole to the meter. No fuses are used. Small insulated-handle switches are, however, utilized to break the circuit for test conditions. The distributing fuse box and service switch are installed in the cellar at a convenient point. Fuses for meter protection are considered economically unnecessary as a result of the comparison of figures for the cost of meter protection and of those for losses through burnouts. Meter accuracy is said to meet reasonable requirements. The plan is being approached slowly, but there are highly desirable features involved. It is estimated that, on a quantity-production basis, the metal cases will pay for themselves in less than a year when lost hours and income are evaluated in connection with installation charges.

* * * *

Super-Codes for Wiring and Lighting

PROGRESS in the introduction of improved devices and methods has come largely through selling efforts by the manufacturers or by broadcasting the information through technical publications and conventions. This has always worked well and doubtless will continue so to do, but as time goes on cases are arising with increasing frequency where co-operative action by the industry is needed. One of the best examples of a co-operative effort of the industry directed to a specific purpose and accomplishing far-reaching results was the promotion of the convenience outlet idea in California in 1919-1922. Where the issues are more complex promotional effort is needed not merely to popularize the device or idea, but to prevent unfairness due to the large number of materials and methods involved. Of this class there is already one prominent example—the "red seal" plan—and more are apparently in the making.

An opportunity for co-operative effort exists in the illumination field. The Illuminating Engineering Society has drawn up codes for several classes of lighting, some of which have been made legal in various states. State laws can go no further, however, than to regulate matters pertaining to public health and safety. In illumination, as in many other things, there is quite a margin between minimum legal requirements and standards of good or desirable practice. But would it not be possible to draw up and get the general indorsement of the industry for certain super-codes of lighting of various classes which would in time come to be recognized as common standards of excellence? In other words, why not a "red seal" specification for the lighting of offices, another for industrial lighting, and so on?

Such specifications would naturally fall to the Illuminating Engineering Society. The promotion of the idea and practical working out of the plan would naturally be done through co-operative industry organizations, as in the case of "red seal" wiring. Such a movement would put a considerable check on the activities of numerous unscrupulous and ignorant salesmen working in the illumination field and would provide the customer and the conscientious illumination salesman with a standard by which to judge, or to have judged, the good and bad qualities of a lighting installation.

A start in this direction has already been made in Chicago under the name of the "Franklin specification," by which residence lighting fixtures for use in a refixturing campaign receive a Franklin specification certificate tag if passed by a technical committee. A Franklin specification for commercial lighting has also been promulgated. Local initiative in such things is desirable, for out of such local experiments come the most successful national movements.

* * * *

Attacking Operating Problems Instrumentally

MEASUREMENT has been vital to electrical progress from its earliest days. Qualitative attacks upon involved problems and complex phenomena have been of little use to the engineer. Only as facilities for scaling quantities and values have been developed have control of energy in transmission and other links in the chain connecting sources of power and its utilizing equipment advanced toward mastery. This is an outstanding lesson of a paper by A. C. Monteith before the recent Midwest Power Conference on development in transmission apparatus tending to increase the reliability and efficiency of its service. The industry is surely entering an era of more accurate appraisal of transmission phenomena, and the next few years are bound to witness many striking advances in the collection, interpretation and interchange of vital information upon the many problems of successful energy transfer.

Instrumentation—using the term in a broad sense—lies back of modern studies of surges, characteristics of insulators, flashovers, relaying, checking apparatus design against operating performance and the control of frequency and voltage regulation. Recent developments in devices for the recording of extremely rapid phenomena on high-tension lines have opened a new door to the operating engineer, and these, combined with improvements and experiments in various auxiliary apparatus fields, promise much from the standpoints of reliability and efficiency. Money spent upon analyses now available through the skilled use and interpretation of improved forms of oscillographs and other means of reading subinstantaneous values will repay those who thus put their confidence in the latest methods. Field instrumentation has limitations of considerable magnitude, and the goal of the transmission engineer is still far off; for a vast amount of work must be done in the fields of apparatus design and analysis of operating situations before the anticipated standards of service will be attained in the face of lightning and other difficulties. But at least it has been made clear by Mr. Monteith and others that power men are "on their way" toward overcoming obstacles to service through the use of improved tools of engineering research.

Cutting Departmental Red Tape

COMPLEX organizations created by the growth of power systems are doubtless essential to successful operation. It is possible, however, to carry organization refinements too far in the conduct of departmental affairs. Observation of such activities at close range indicates that on some properties a rigid application of account classifications in small matters may defeat its own ends. In a generating plant, for example, a fireman breaks a mirror in the boiler washroom. A replacement order starts on its way up the ladder of officialdom. It receives the successive approvals of the boiler-room foreman, chief engineer, assistant superintendent and superintendent of the production department, and then arrives on the purchasing agent's desk. Alas, poor Yorick! The mirror is pronounced, not steam-plant equipment, but furniture. Some other department officials' approval is required, seriatim, and after various delays for which no individual is to blame, the purchasing agent calls for competitive bids, and the machinery of office routine finally delivers a new mirror to the automobile department, which hauls it to the plant at a departmental charge of 25 cents per mile or less and delivers it in exchange for a receipt whose journeyings back to the "P.D." file need not be chronicled.

The moral of this and similar episodes is that there is a field for a limited petty cash or miscellaneous expense allowance under control of the ranking officer of the department needing minor supplies. Too often, we fear, high-salaried executives and their staffs in many companies find their conference proceedings encumbered by topics of petty-cash importance over which departments disagree, thanks to the elaborateness of the prevailing accounting system. Is not a larger sense of proportion needed in these cases and cannot trusted subordinates be allowed more latitude in reference to making minor purchases than at present exists? Why use sledgehammers to kill mosquitoes?

* * * *

Home-Modernizing Movement Deserves Hearty Support

EVERY branch of the electrical industry should be keenly interested in the national movement to stimulate the modernizing of old homes that is right now being organized. The plan springs from three conditions:

1. There are some ten million homes in the country with obsolete equipment that modernizing would restore to full market values.
2. There is an enormous fund of money now in building and loan associations seeking investment.
3. The building trades are at present experiencing a slump with attendant unemployment.

This situation naturally suggests the possibility of a comprehensive national program for the remodeling and re-equipment of these homes to provide employment and investment and to recreate real-estate values through modernization. The scope of such a movement grips the imagination.

Some thirty-one industries and trades have interested themselves in the idea. They embrace lumber, paint, steel, cement, brick, gypsum, asphalt, insulation, plumbing, heating, bathroom and kitchen equipment, gas, electricity, real estate, and building and loan interests, with many representatives of special groups such as oak flooring, shingles, metal lath and the like. They plan to pro-

mote local modernizing campaigns in which civic beautification and other public interests will be invoked, and it would seem that the purposes involved would have a strong popular appeal.

The interest of the electrical industry is obvious. The inadequacy of house wiring is giving serious concern, because it blocks both the sale of appliances and the consumption of kilowatts. The manufacturers of wiring materials are suffering from overproduction. The contractors are facing a dwindling market in residence wiring. Jobbers and dealers are vitally affected. Electrical wiring and equipment will play a prominent part in the rehabilitation of these countless old homes so conspicuous in all cities. Therefore the electrical industry should support and help promote this movement, with a co-operating joint committee, in position to speak for all four of our national group associations. W. H. Hodge of the N.E.L.A. Commercial Section is chairman of a committee representing the electrical industry in this movement.

* * * *

The Private-Plant Bugaboo

MUCH ado is made about the use of private plants in industries. This is true even in those cases where the use of large amounts of process steam or other local conditions point very positively to the private plant as the economic solution when all cost and service values are studied. Any utility company should take the position that its duty is first to the industry it serves. If a proper analysis shows that any particular industry should make its own electricity, the utility should be first to advise such a course. This case will be the exception, and it will not mean a total loss to the utility, for there will be indirect benefits. Every employee of an industry must have electric service in his home; the community streets must be lighted; there are stores and other industries to be developed and thus a very large business for the utility is made possible. It may be far more profitable than a power business done at no profit.

* * * *

Overcapacity of Industry a Logical Condition

OVERCAPACITY of industry is a much-abused term owing mainly to a lack of the proper appraisal of the trend of business. What constitutes an apparent overcapacity is mainly an economic growth based on the tendency to increased efficiency in production. A very important factor has been a decrease in the cost of production. This has been obtained through the addition of new machinery even to the extent of building new plants, and the industry is equipped with a capacity distinctly larger than is needed to meet current consumption—a logical condition because of expectations of business growth. The danger lies not in this temporary overcapacity but in the effort of each executive to get business in a factory designed to meet future demands by taking work from a competitive factory through the use of price levers. If overcapacity is balanced against the need that created it, if current markets are analyzed, if future growth is measured and if new markets are aggressively cultivated, overcapacity will cease to be a bugbear and become the marginal reserve necessary to any well-conducted enterprise.

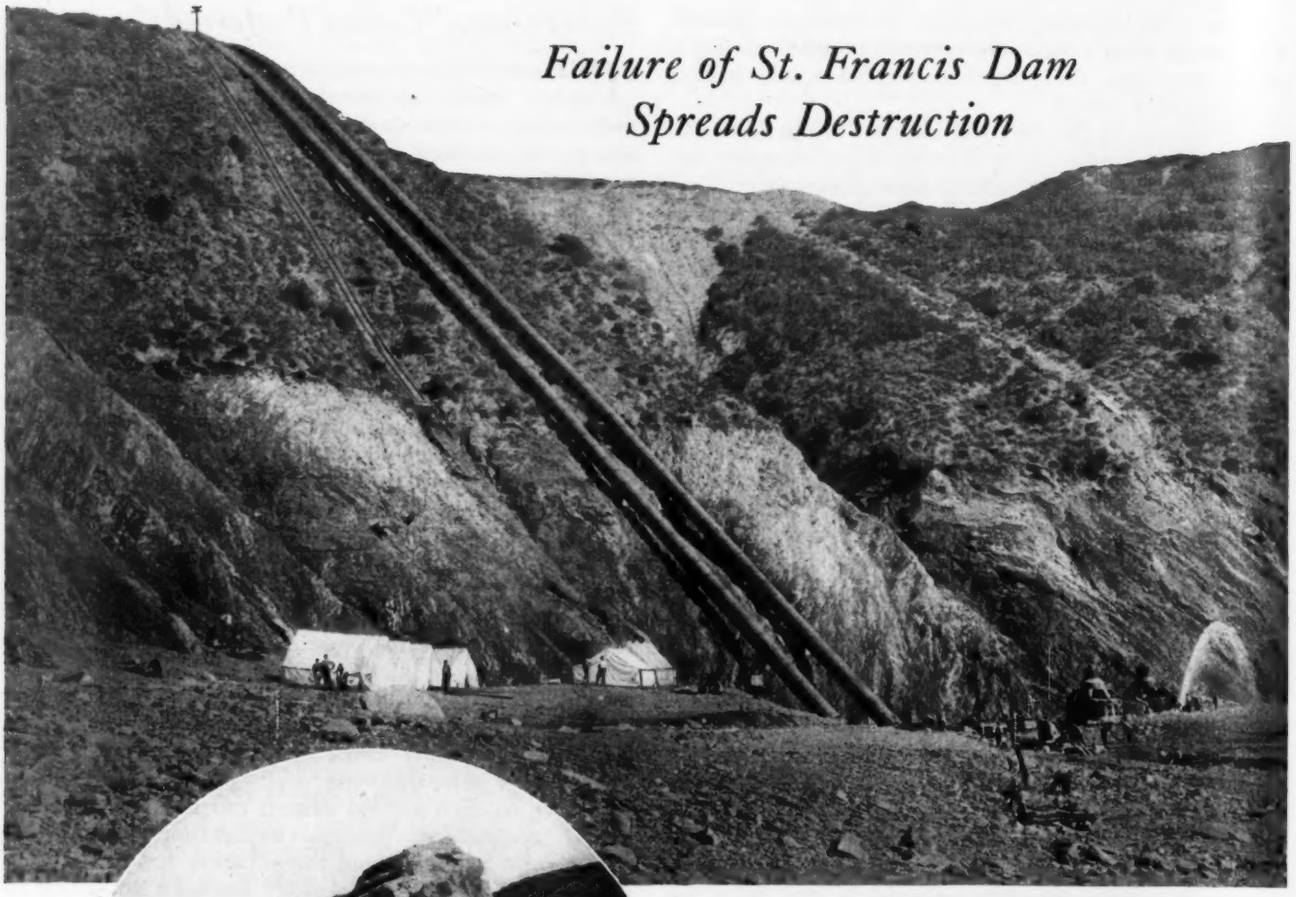
Reinvesting "Called Preferreds"

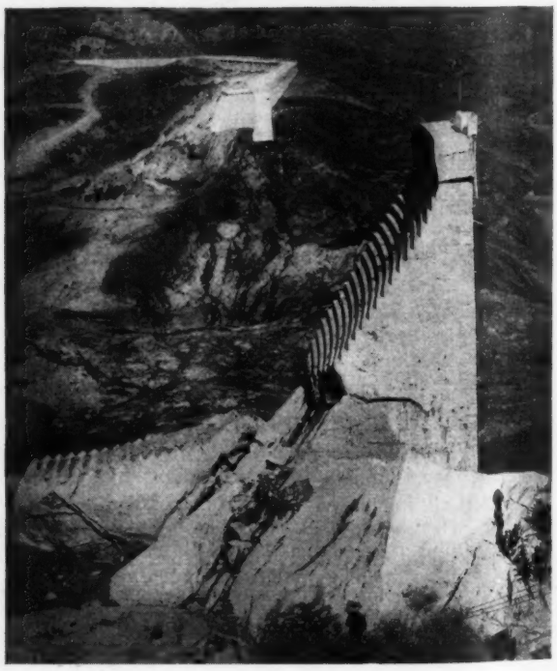
THE present downward trend in yields on high-grade public utility preferred stocks has a bearing on public relations that should not be overlooked by bankers and power company executives. Thousands upon thousands of customers and employees are facing the problem of reinvesting the proceeds of preferred stocks which have been redeemed at stated call prices, and the need of good advice and sound action is great. Probably most of these particular security owners are reaping a profit on the purchase price of their holdings. This is well, but when they approach the matter of yield on current reinvestment opportunities the picture changes. A definite reduction in income from preferred issues stares them in the face, and the course for the customer or employee owner to follow needs sympathetic consideration by the investment banker and by the utility man concerned in the distribution of company securities.

It is not enough to point out that the callable feature of a preferred stock formerly paying, say, 7 or 8 per cent was printed on the certificate and that the buyer who assumed that these rates would be continued for two or three decades after the close of the war has only himself to blame if he is upset over the termination of such returns. Nor is it sufficient to point out that countless security owners are receiving good profits on their transactions. The utility which has conducted vigorous customer-owner campaigns may well go beyond this purely defensive position and do what it can to render its preferred stockholders financial explanations which will enable them to understand the situation and in the long run to suffer as little as possible from a change due to the working out of the unchangeable law of supply and demand. This service may be given by the utility itself or by investment banking houses in close touch with the property, but where the operating or holding company has sought investment money from customers or employees, it now has a real opportunity to perform an important task in public relations by helping its investors to adjust themselves to the new conditions.

Various incentives to reinvest in the lower-rate preferreds are being offered holders of called stocks. Without cataloging these, it appears that in many cases the owner may share in the future prosperity of the company by participating in common-stock dividends above a stated figure, by converting the new preferred shares into common on favorable terms, or by receiving the right to buy common shares at established prices during a stated period, regardless of the market. These advantages appeal to some owners but not to others. An alternative is, of course, to invest the proceeds of the redeemed preferreds in utility common stock or bonds. The value of recurring rights to share in company growth through common-stock ownership increases the yield rate over a given period, and the high repute of common stocks of first-class companies as collateral for loans deserve to be emphasized. In many cases, indeed, the preferred stockholder need lose little or no income if he "switches" with intelligence, and opportunities still exist, indeed, for actual increase of total income through purchase of listed equities. For others the possibilities of bond appreciation should not be overlooked. Without embarking on a program of responsibility for advice concerning investments, utility companies face an opportunity to build warm business friendships with customer and employee owners during this transition period in security values.

Failure of St. Francis Dam Spreads Destruction





NEAR midnight on March 12 the St. Francis Dam, in southern California, failed, releasing 38,000 acre-ft. of water, creating a flood estimated at between 500,000 and 900,000 sec.-ft., sweeping destruction to the valley below. Loss of life is estimated at 300 persons and property damage will amount to approximately $25,000,000.

Top—Remains of San Francisquito power house No. 2 showing two 26,250-kw. generators in the débris.
In circle—Section weighing 5,000 tons swept 2,000 ft.
Above—Dam failed first on far side of river canyon.
Left—Central portion of dam remained standing.

Single-Phase Condenser Motor

Recent investigation and development of improved power factor motors indicate high attainable efficiency. Construction cost not a deterrent factor

By Prof. BENJ. F. BAILEY
University of Michigan

The general characteristics of fractional-horsepower motors, the effect of design upon economy of operation, the application requirements of the several types and the desirability of motor improvements were discussed by Professor Bailey in the March 24 issue of ELECTRICAL WORLD, *page 597. The design, performance and operation of fractional-horsepower, single-phase condenser motors, offered as a corrective solution of the problem, are detailed in this second and final installment.*—EDITOR.

THE fundamental idea of the condenser motor is old, but so far as I am able to find out no serious investigation of its possibilities has previously been made. The connections of a condenser motor are shown in Fig. 1. As in the split-phase motor, there are two windings, 90 electrical degrees from each other. The winding 2, however, would usually have approximately as much copper in it as the winding 1, although the number of turns in the two windings need not be the same. In most cases it would be advantageous to use more turns in winding 2 than in winding 1 and a correspondingly smaller size of wire, making the weight of the two windings approximately equal. Instead of a resistor we use a condenser C connected in phase 2; this condenser remains permanently in circuit, although, as will be shown, it is usually advisable to use more capacitance when starting than when running.

The vector diagram of the motor when starting is shown in Fig. 2. The current in the winding I_1 lags by approximately the same angle as before, but by using a proper value of the capacitance the current in winding 2 may be made to lead. The total current is of course the vector sum of the two and may be made to be very nearly in phase with the voltage. The motor has therefore nearly 100 per cent power factor when starting. The angle α between I_1 and I_2 may be made nearly 90 deg. The starting torque for the same phase currents is therefore much greater and the sum of the currents is less, since they are added together at approximately 90-deg. phase difference.

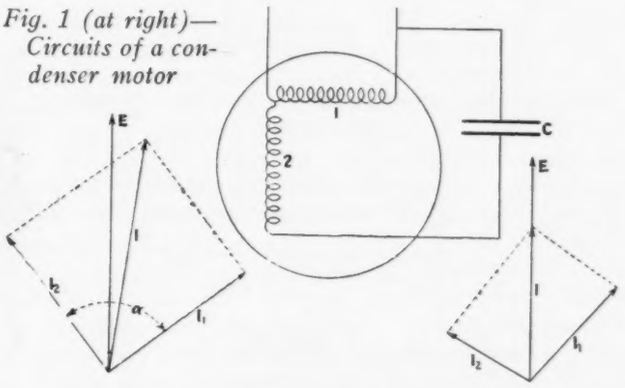
The starting torque of the motor, in fact, can be made as great as or greater than that of a polyphase motor, and since the currents add at nearly 90 deg. the line current will be less. The motor will therefore develop about the same torque as a polyphase motor with about 70 per cent as much current, giving a decidedly higher starting efficiency.

As in the case of the ordinary single-phase motor, the starting torque can, if necessary, be very much increased by reducing the number of turns in the winding 2. In general, however, the winding 2 may have more turns than the winding 1 and the motor will still develop ample starting torque. This enables us to use a smaller and cheaper condenser.

The vector diagram of this motor under full load and 100 per cent power factor is shown in Fig. 3. The current I_1 lags less than when the motor is starting and the current I_2 with the proper value of capacitance is nearly at right angles to I_1. The motor is therefore operating practically as a two-phase motor. It has the advantage over the latter, however, in that the currents I_1 and I_2 combine at such an angle that their resultant I, which is of course the line current, may be in phase with the line voltage E. The line current may of course be made to lead the line voltage if this is desirable.

If the capacitance of the condenser is so adjusted that the motor gives its best all-around performance under normal load it will be found that the starting torque with the same condenser will be quite low, usually in the neighborhood of 50 per cent. By using a condenser several times as large as this the starting torque can be increased to from 200 to 400 per cent. If the static torque of the load to be started is very low, but increases rapidly with the speed, a motor with a fixed condenser may be satisfactory. For example, a fan requires very little torque at the instant of starting and the necessary torque increases approximately as the square of the speed. A motor using a condenser adapted to give the best running conditions will be found to have a similar speed-torque curve (see Fig. 17), and hence may be used with advantage for such an application. Centrifugal pumps and grinders also have such speed-torque characteristics that they can probably be satisfactorily handled with a fixed condenser.

Fig. 1 (at right)—Circuits of a condenser motor



Figs. 2 and 3—Vector diagram of condenser motor when starting and condenser motor vectors when at full load and 100 per cent power factor

If, however, the motor must start a load such as a refrigerator compressor having large static friction it will be necessary to use a much greater value of the condenser at start and then reduce this to a suitable value for normal running. One method of doing this is shown in Fig. 4. Switch S, which may be operated either by a relay or by centrifugal force, is used to disconnect the condenser C_2 as soon as the motor has reached about two-thirds of normal running speed.

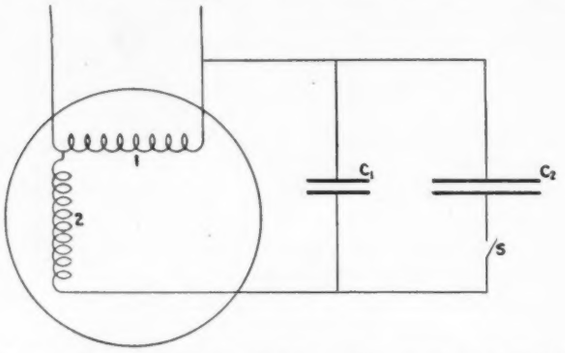


Fig. 4—Method of varying capacitance after starting with high value

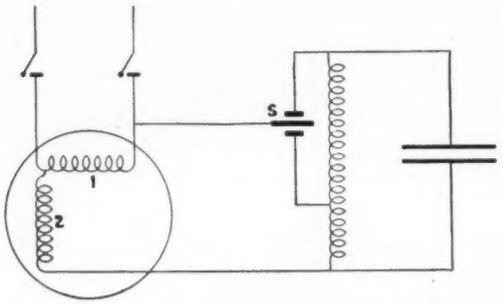


Fig. 5—Method of varying capacitance by use of transformer

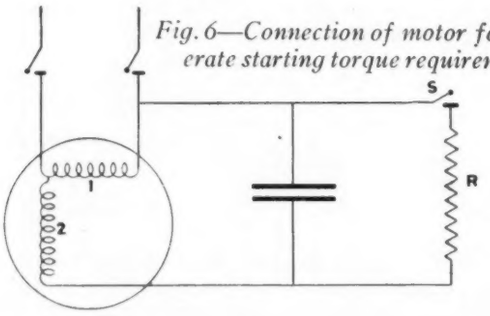


Fig. 6—Connection of motor for moderate starting torque requirements

Since the condenser C_2 may have several times the capacitance of the condenser C_1 its cost would be excessive if it were of the usual construction. This would be particularly true in the case of low-voltage motors. One method of reducing this cost is to use an electrolytic condenser in the place of C_2.

Electrolytic condensers have been known for a number of years. They consist essentially of two plates of aluminum immersed in a proper solution. Borax is frequently used for this purpose. The plates are first formed by passing direct current through them until a very thin film has been formed on the surface of the plates. Each plate then acts as an electric valve, allowing the current to flow in one direction only. Since the film is very thin such a condenser has an enormous electrostatic capacity in proportion to the size of the plates.

Electrolytic condensers have not been used to any great extent on account of their comparatively high loss. A paper condenser will have a power factor of approximately 0.5 per cent, whereas an electrolytic condenser will have a power factor of from 10 to 30 per cent. This large loss is of course objectionable in itself and in addition causes the cell gradually to lose its rectifying properties. It is therefore impracticable to use these condensers in continuous work where any large amount of power is involved.

For starting a condenser motor these disadvantages largely disappear. The increased loss results in only a small reduction of starting torque and the starting period is so short that the rise in temperature of the solution is negligible. Evaporation from a properly constructed electrolytic condenser can be made very slow, so that water need be added not oftener than once every two years. A rather crude home-made elctrolytic condenser has been operating in connection with a condenser motor driving the compressor of an electric refrigerator under my observation for twenty months. During this time it has had absolutely no attention. The level of the liquid due to evaporation has not lowered more than $\frac{1}{16}$ in. During one summer the outfit stood idle for about two months without any apparent depreciation.

Another connection designed to effect the same object is shown in Fig. 5. A condenser is connected to the motor through a variable ratio transformer. Preferably an auto-transformer is used, since this is somewhat cheaper and more efficient than the ordinary type of transformer.

At the instant of start the switch S is closed on the lower contact of the transformer. The voltage applied to the condenser is increased and the current taken by the condenser is increased in the same ratio. The current flowing through the motor circuit is again increased by this same ratio due to transformer action. For normal running the switch closes on the upper contact and the effect of the condenser is correspondingly reduced. The upper tap on the auto-transformer, at least for higher voltage motors, might preferably be made at the extreme upper end. In normal running the transformer would therefore be inactive. Providing the necessary switches were not too complicated it might be entirely disconnected.

It is obvious that with this scheme a condenser of smaller capacitance may be used. On the other hand, it must not be forgotten that the thickness of the dielectric must be sufficient to stand the higher voltage. If we compare the condensers on the basis of their volt-ampere capacity this scheme effects no saving. It is, however, true that a condenser of a given volt-ampere capacity is less costly at say 440 volts than at 220. This saving is at least partially offset by the cost of the auto-transformer and the cost of the more complicated switch. There is, of course, a constant loss in the transformer and this reduces the running efficiency of the motor by about 2 to 4 per cent.

If only a moderate starting torque is necessary and if a comparatively large starting current is not objectionable the scheme shown in Fig. 6 may be used. Here a resistor is substituted for the condenser C_2. A motor operated in this manner will have better starting characteristics than a plain split-phase motor, but will, of course, not be so good in this respect as the condenser motor. The scheme is obviously cheap and might perhaps be satisfactory in connection with such applications as motors for oil burners or washing machine motors.

In Fig. 7 I have shown the characteristic curves of a condenser motor and those of the best motor that I have found of the ordinary repulsion-induction type. Both motors are of the same rating, namely, ¼ hp., 1,800 r.p.m., 60 cycles and 110 volts. The full load efficiency of the condenser motor is 75 per cent, that of the repulsion-induction motor 64 per cent. In other words, the customer's bill for the condenser motor would be 85 per cent of that with the best available repulsion-induction motor.

The power factor of the condenser motor at full load was 86 per cent, that of the other 66 per cent. By using a larger condenser the power factor of the condenser motor could be raised to 100 per cent.

The apparent efficiency of the condenser motor at full load is 64 per cent and that of the repulsion-induction motor 42 per cent. The corresponding full load currents are respectively 2.6 amp. and 4 amp.

In building the condenser motor a standard split-phase ¼-hp. motor was used. The stator winding was removed and replaced by a winding suitable for the condenser motor, otherwise the motor was unchanged. The total weight of the motor exclusive of condensers was 28 lb., whereas the repulsion-induction motor with which it was compared weighed 43 lb. I wish to make it clear that the improvement in characteristics was not obtained by using a large and expensive motor. It should also be emphasized that the repulsion-induction motor with which it is compared is one of the best, if not the best, on the market. For example, the full-load current of this motor was 4 amp. Other motors of the same rating which I have tested have taken full-load currents as large as 6.5 amp., giving an apparent efficiency of only 25.5 per cent. In Fig. 8 I have shown these same data graphically. In addition it will be noted that these two motors develop approximately the same locked torque. The locked current of the condenser motor is, however, 41 per cent greater than that of the repulsion-induction motor and its starting efficiency is correspondingly lower. The pull-out torques of the two motors are approximately the same.

In Fig. 9 I have shown a similar comparison between the same condenser motor and the best of a number of split-phase motors tested. The difference in efficiency,

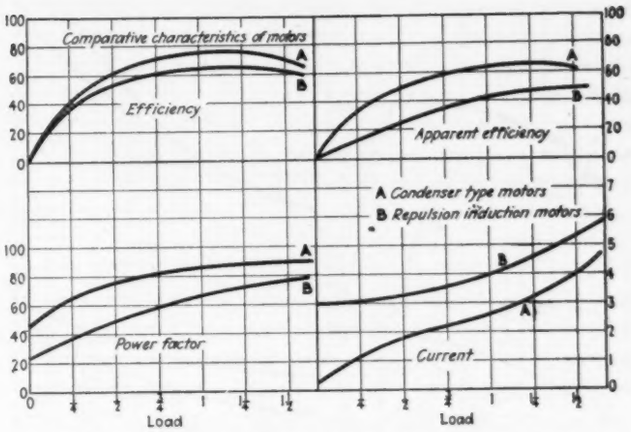


Fig. 7—Characteristic curves of condenser and repulsion-induction motors

power factor, apparent efficiency and current is even more marked than before. In fact, it will be seen that the full-load current of the split-phase motor is nearly double that of the condenser motor. The locked torque of the split-phase motor is much less than that of the condenser motor and its locked current is much greater. The torque per ampere of the condenser motor is nearly four times as great as that of the split-phase motor, as indicated by the comparative starting efficiency. In pull-out torque the two are about the same.

Comparison of Two-Phase and Condenser Motors

In order to get an accurate comparison between a polyphase motor and a condenser motor a standard ½-hp., 1,800-r.p.m., two-phase, 60-cycle, 220-volt motor was obtained. This motor was first carefully tested as a two-phase motor, with the results shown in Fig. 10. Without any change whatever the motor was then connected as a condenser motor, with the results shown in the same figure. It should be noted that the efficiency of the single-phase compares well with that of the two-phase. It is, however, slightly lower at light loads and at overloads due to the fact that the currents do not divide evenly between the two windings. This naturally results in greater I^2R loss. At full load the efficiencies are prac-

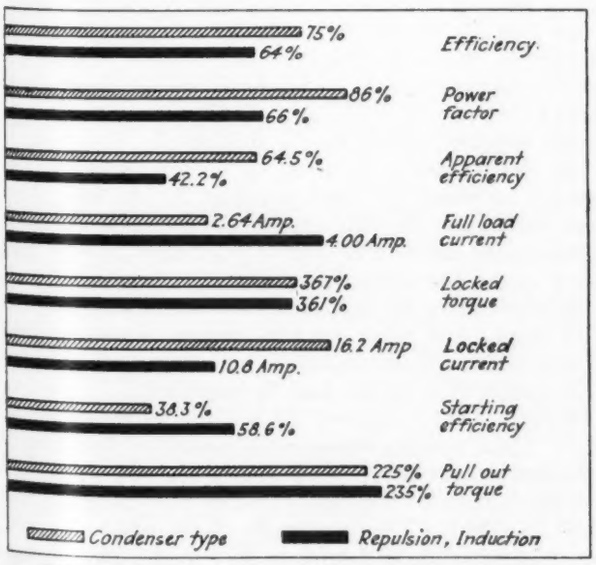


Fig. 8—Graphic comparison of condenser and repulsion-induction motors

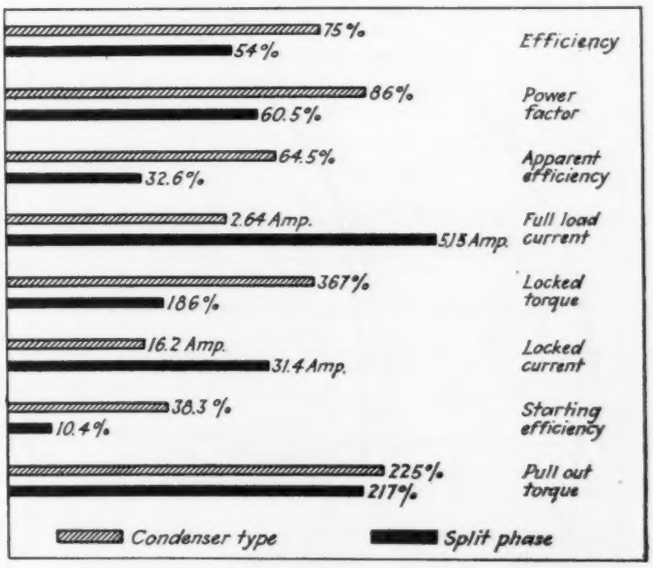


Fig. 9—Graphic comparison of condenser and split-phase motors

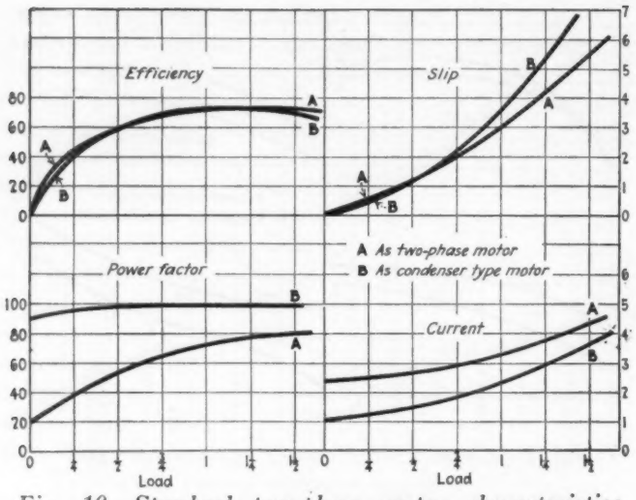


Fig. 10—Standard two-phase motor characteristics compared to operation as a condenser motor

tically the same. The power factor of the single-phase motor is much the better, being nearly 100 per cent throughout the usual working range. The slip in the two types of motor is practically the same. Since the efficiencies at full load are nearly the same, there is but little difference in heating at full load. The rating as a single-phase motor would be nearly as great as that of the two-phase motor.

The pull-out torque of the single-phase motor is, however, decidedly less. With the particular value of capacitance used it was 207 per cent, in comparison with 316 per cent in the case of the motor operated two phase. It was, however, amply high for all practical purposes and could have been made still higher by using somewhat greater capacitance.

The starting characteristics are shown in the following table:

	Starting Characteristics				Ratio Winding 1 to 1, Power Factor, Per Cent
	Torque, Per Cent	Starting Current	Starting Watts	Starting Efficiency, Per Cent	
Two-phase	307	19.7	2,980	26.3	68.8
Single-phase condenser motor	362	17.72	3,880	34.5	99.5

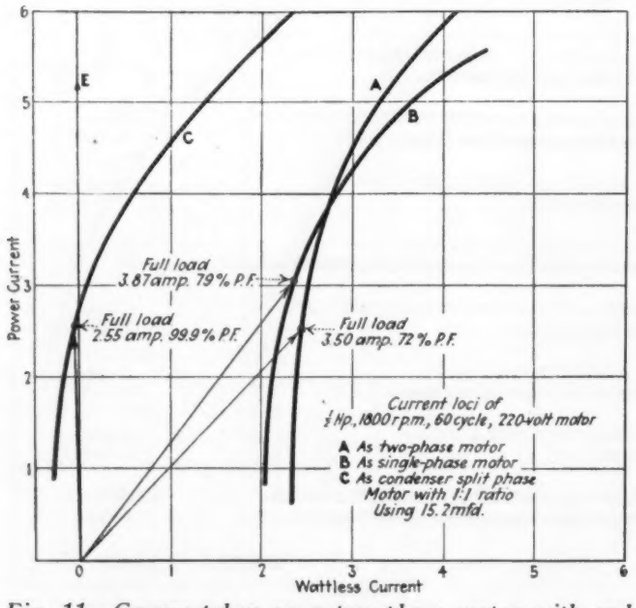

E
A
B
C
Full load 3.87amp. 79% P.F.
Full load 2.55 amp. 99.9% P.F.
Full load 3.50 amp. 72% P.F.
Current loci of ¼ Hp, 1800 rpm, 60 cycle, 220-volt motor
A As two-phase motor
B As single-phase motor
C As condenser split phase Motor with 1:1 ratio Using 15.2 mfd.
Power Current
Wattless Current

Fig. 11—Curves taken on a two-phase motor with and without condenser

It will be seen that the condenser motor has considerably more starting torque than the two-phase motor. If necessary, this could have been greatly increased by reducing the number of turns in the auxiliary winding. The starting current of the two-phase motor was 9.85 amp. per phase, or 19.7 amp. in all, whereas the single-phase motor required only 17.72 amp., or approximately 90 per cent as much. The single-phase motor necessarily took more power in starting, but its starting efficiency was much better. The power factor at start of the single-phase motor was 99.5 per cent and that of the two-phase motor 68.8 per cent. It is apparent that the starting characteristics of this type of motor are better even than those of a polyphase motor. Moreover, they can be varied to suit different conditions by changing the ratio of turns in the two windings and by changing the capacitance.

Fig. 11 will help to make clear the relative action of the two-phase, single-phase and condenser motors. These curves were all taken with a small two-phase motor. Curve *A* shows the locus of the current when the motor is operated two-phase. The angle between the vector marked *E* and any line drawn from the origin to the curve *A* indicates the lag of the current behind the voltage. The cosine of this angle is of course the power factor. In order to make the curves comparable the current plotted is that taken by both phases of the two-phase motor. It will be evident that the power factor will rise to a maximum at somewhat above full load and will then decrease for greater loads than this.

Similarly, curve *B* shows the locus of the current when operating on one of the two phases. It will be seen that in general the power factor of the single-phase motor is worse than that of the two-phase motor, particularly for heavy loads. By adding a condenser and connecting as shown in Fig. 1 we obtained the curve marked *C*. At light loads the current leads the voltage by a small angle. At full load it is nearly in phase with it, giving practically 100 per cent power factor, and for overloads the current lags, giving a power factor slightly lower than unity. The decided improvement in power factor will be evident from the diagram.

Fig. 12 is a more complete locus diagram of the different voltages and currents under various loads. The line voltage marked *E* is taken as axis of reference and of course remains constant. The curve marked "current in winding 1" shows the variation in circuit 1 as the load on the motor is changed. The current in circuit 2 remains nearly constant, as is shown by the short curve marked "current in winding 2." Obviously the power in this winding is also nearly constant.

The line current is obtained by adding vectorially the currents in winding 1 and winding 2. As is evident from the figure, the line current at all loads is nearly in phase with the voltage, giving practically 100 per cent power factor for all loads. As before, the line current is slightly leading for light loads and slightly lagging for heavy ones. The curve marked "voltage across winding 2" shows that this voltage does not vary much, but decreases somewhat as the load is increased.

In Fig. 12 the two windings had the same number of turns. Each winding, however, consisted of two circuits connected in parallel. By connecting the two circuits of winding 2 in series the ratio of turns was changed from 1 to 1 to 2 to 1. The capacitance of the condenser used was reduced from 15.2 mfd. to 6.75 mfd. Since it was subjected to a higher voltage, however, the volt-amperes in the condenser remained practically the same. (Fig. 13.)

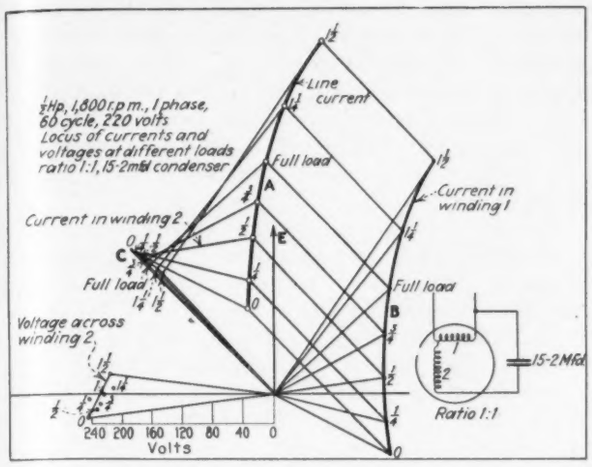


Fig. 12—Complete locus diagram of condenser motor with 1 to 1 ratio of turns

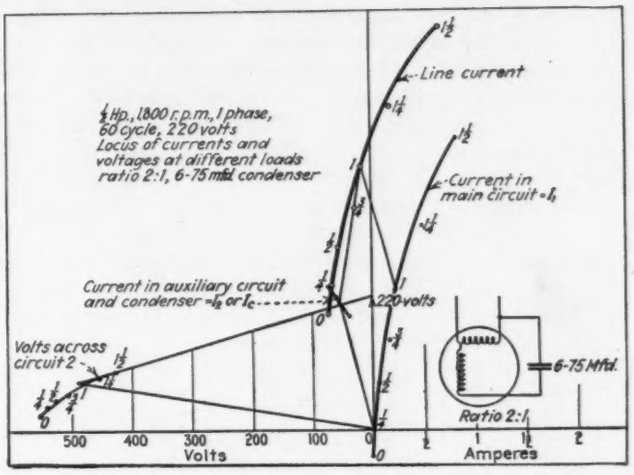

¼ Hp., 1800 r.p.m., 1 phase, 60 cycle, 220 volts
Locus of currents and voltages at different loads
ratio 2:1, 6-75 mfd condenser
Line current
Current in main circuit = I1
Current in auxiliary circuit and condenser = I2 or Ic
220 volts
Volts across circuit 2
6-75 Mfd.
Ratio 2:1
500 400 300 200 100 0
Volts
0 ½ 1 1½ 2
Amperes

Fig. 13—Locus diagram of condenser motor with 2 to 1 ratio of turns

As before, the power and current in the condenser circuit remain practically constant. Obviously this current must be at right angles to the condenser voltage represented by the line drawn from the end of the voltage vector to any point on the curve marked "voltage across circuit 2." Since the voltage across circuit 2 is nearly twice as great as before, the condenser voltage is more nearly at right angles to the line voltage. The current is therefore more nearly in phase with the line voltage and as a result forces the current in circuit 1 also to be nearly in phase with the line voltage. As before, the vector sum of these two currents gives the line current. This leads slightly at light loads and lags somewhat at heavy loads, giving 100 per cent power factor at approximately full load. The use of a high ratio enables us to use a condenser of small capacitance, and it is therefore somewhat cheaper, although the volt-ampere capacity is approximately the same. It will be evident that the currents in the two windings are far from being 90 deg. from one another and therefore are not in the best relation to give high efficiency and large overload capacity to the motor.

Change of Performance with Capacitance

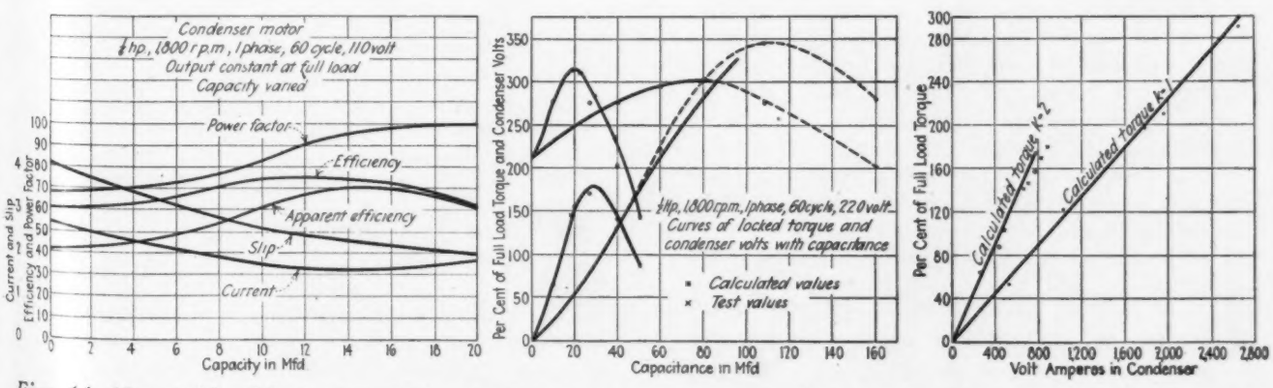
In Fig. 14 I have shown what happens in a small condenser motor operating with different values of capacitance. The output of the motor was held constant at ¼ hp. and the capacitance varied from zero to 20 mfd.

With zero capacitance the motor, of course, operated like the usual split-phase or repulsion-induction motor. Its efficiency and power factor were both low and the current and slip high. As the capacitance was increased the efficiency improved, reaching its maximum at about 12 mfd. Beyond this point it again decreased. The point of best efficiency is reached when the currents in the two windings are approximately proportional to the cross-section of the wires used. This results in minimum copper loss and high efficiency.

The highest power factor, namely, 100 per cent, was attained with 18 mfd. The efficiency, however, was decidedly lower. The highest value of apparent efficiency and the lowest value of current are obtained with approximately 14.5 mfd. The slip continually decreases as the capacitance is increased. The best all-around performance of this motor is obtained with approximately 12 mfd., although its characteristics are nearly as good with only 10 mfd.

In Fig. 15 I have shown how the starting torque varies with the capacitance. These tests were made on the same motor previously used in obtaining the curves of Figs. 12 and 13. When operated with a ratio of 1 to 1 the torque rose to a maximum of nearly 350 per cent with 110 mfd. The torque can be computed by fairly simple methods and both the observed and calculated values are shown on the curve.

The smaller curve at the left shows the starting performance of the motor when connected with a ratio of 2 to 1. The maximum torque is half as great as before and is obtained with only one-quarter as much capacitance. The microfarads required per pound foot are


Condenser motor
¼ hp., 1800 r.p.m., 1 phase, 60 cycle, 110 volt
Output constant at full load
Capacity varied
Power factor
Efficiency
Apparent efficiency
Slip
Current
Current and Slip
Efficiency and Power Factor
Capacity in Mfd
Per Cent of Full Load Torque and Condenser Volts
¼ Hp., 1800 r.p.m., 1 phase, 60 cycle, 220 volt
Curves of locked torque and condenser volts with capacitance
Calculated values
Test values
Capacitance in Mfd
Per Cent of Full Load Torque
Calculated torque K=2
Calculated torque K=1
Volt Amperes in Condenser

Figs. 14, 15 and 16—Effect of variable capacitance on performance and on starting torque and relation between volt-amperes and torque of condenser motor—points calculated, curves observed

therefore only half as great. In designing one of these motors, so far as starting torque is concerned, the cheapest construction will be obtained by using as high a ratio of turns as will allow us to obtain the necessary starting torque. If necessary, the torque could be made exceedingly great by using a very low ratio, but only with a very large and expensive condenser. The two other curves starting from 220 volts show the voltage across the condenser with different values of capacitance. The peaks of these two curves should theoretically reach the same maximum value. The differences observed are probably due to the difficulty of keeping the temperature

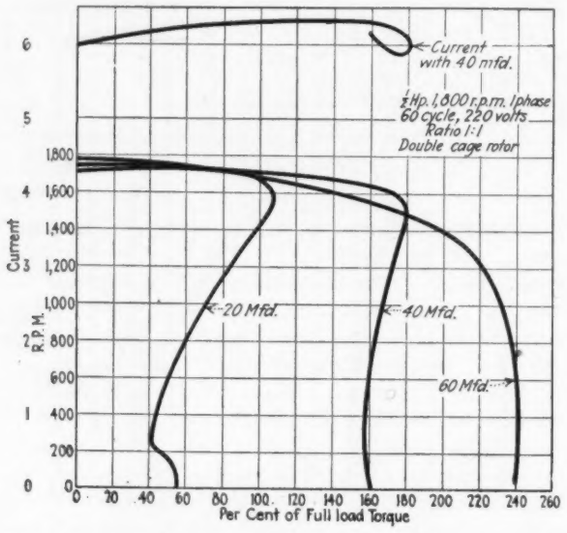

Current with 40 mfd.
¼ Hp. 1,800 r.p.m. 1phase 60 cycle, 220 volts Ratio 1:1 Double cage rotor
20 Mfd.
40 Mfd.
60 Mfd.
Current
R.P.M.
Per Cent of Full load Torque

Fig. 17—Speed-torque curves of a condenser motor

of the motor constant with the heavy starting currents used.

In Fig. 16 I have plotted the volt-amperes in the condenser and the per cent of full-load torque. The volt-amperes are of course obtained by multiplying the current in the condenser by the voltage at its terminals and may be obtained from the preceding curves by a simple calculation. It can be shown theoretically that these curves should be straight lines and this is confirmed by the tests. As before, with the ratio of 2 to 1, only half as much condenser capacity per pound foot is required as with the ratio of 1 to 1.

The curves of Figs. 15 and 16 referred to the locked torque of the motor. This is, of course, important, but it by no means tells the whole story of the starting ability of a motor. A frequent complaint in connection with the repulsion-induction motor is that while it will start the load it will not pull it up to speed. In Fig. 17 I have plotted the complete speed-torque curves of this same motor. It will be seen that the torque remains nearly constant from standstill until the motor has attained normal running speed. However, with a small value of capacitance there is a decided increase of torque as the motor speeds up. This, as was previously pointed out, makes it possible to start certain kinds of loads even though the initial torque is rather small.

Fig. 18 will serve to show the possibilities of the condenser motor. The motor in question was rated at only $\frac{1}{6}$ hp. In spite of the small size a full-load efficiency of 73 per cent and maximum efficiency of 75 per cent were attained with a full load power factor of 86 per cent. The motor developed a starting torque of 320 per cent. This large torque was not obtained by the use of a high-resistance rotor, as will be evident from the fact that the slip at full load is only 2.5 per cent. Such performance is entirely beyond the possibility of the split-phase or repulsion-induction motor, or, to put the matter a little differently, no matter how good the performance of a split-phase motor might be, it could be very much improved by rewinding and operating it as a condenser motor.

The above facts serve to show that it is now possible to build single-phase motors nearly equal in efficiency to two-phase motors and far superior in power factor. Compared with split-phase motors, the characteristics of the condenser motor are superior in every respect. They are better than those of the repulsion-induction in every respect except in locked torque per ampere. The pull-in torque, however, is much better than that of the repulsion-induction motor, so that, everything considered, I have no hesitancy in saying that the starting performance also is superior.

Cost the Handicap

At the present time, due to the high cost of condensers, a condenser motor costs somewhat more than the repulsion-induction type and decidedly more than the split-phase motor. It is, of course, too early to predict the difference in price with any real accuracy, but it is apparent that this difference need not exceed $10 in the case of a $\frac{1}{4}$-hp. motor, and if such motors are produced in large quantities the difference will undoubtedly be less. The motor itself will cost about the same as the split-phase motor and decidedly less than the repulsion-induction motor. The condenser is the costly element, but if these are produced in quantities the price can undoubtedly be materially reduced.

Even though this difference should be as much as $10, it is clear that the central station could save more than this if the better motor were used. Unfortunately, there is no obvious way in which the central station can directly finance the introduction of these motors.

The customer would profit by reason of reduced bills. This reduction would amount to from 50 cents to $1 per

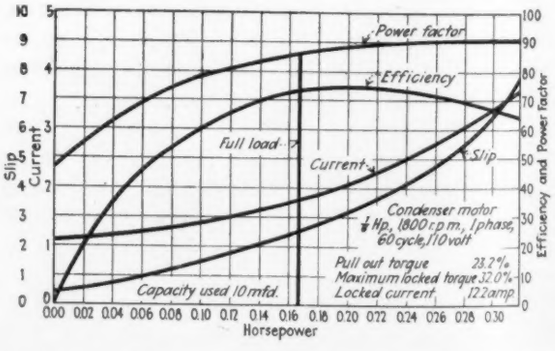


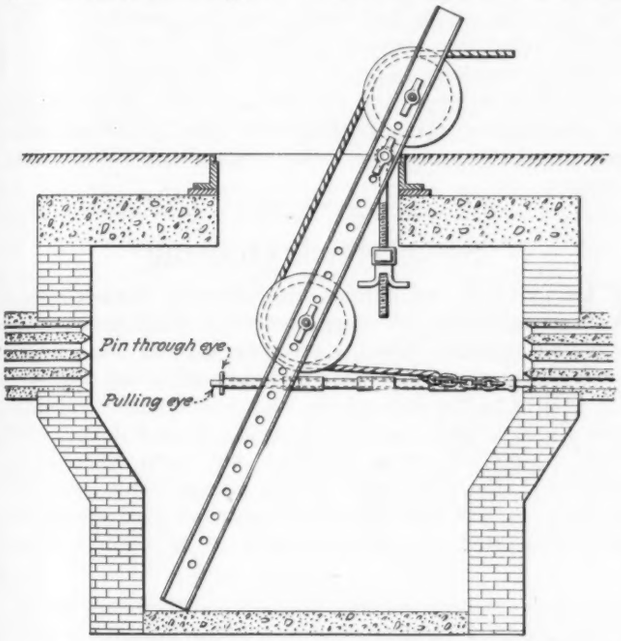
Fig. 18—Performance possibilities of condenser motor

month and would easily pay for the increased cost of the motor in a short time. The fact that the motor is quieter than other types, due to the fact that it operates practically as a two-phase motor, is also of tremendous importance. It may well be that the reduced noise will be the advantage which will result in the introduction of these motors, since the question of noise, particularly in modern apartment houses, where hundreds of refrigerators are running at the same time, is assuming very great importance.

Slack-Pulling Device Protects Cable Sections

By N. E. Buck
Superintendent Underground Cable Work
Commonwealth Edison Company, Chicago, Ill.

AFTER a length of underground cable has been pulled through the duct and approximately to the center of the manhole, or in line with the pulling equipment, it then becomes necessary to pull additional slack to provide a sufficient length of cable to train around the manhole wall. In the past it has been the practice to pull this slack with various kinds of hitches, including woven wire grips. However, if the pull is long, or if the cable is "soft," that is, contains a large percentage of insulation to copper and lead, the lead sheath may be damaged or even broken by such hitches.



Cable slack pulled without straining materials

The Commonwealth Edison Company utilizes a slack-pulling tackle by means of which the necessary amount of slack may be pulled without injury to the cable. The cable is pulled through the duct by means of a pulling eye soldered to the copper and lead, and this eye is left in place until after the slack has been pulled. The device consists of a number of sections of straight steel tubing about 1 ft. long on one end of each of which is welded a steel collar. When the sections are assembled the end of one section enters the collar on the adjacent section, and the several sections of cable together form a very rigid tube. The sections are slipped on the end of the cable in sufficient number to build up a tube equal in length to the slack desired. The section at the cable end is prevented from coming off by means of a heavy pin passed through the pulling eye, and the last section, the one nearest to the duct, is equipped with a sling, to which the cable-pulling rope is attached. The slack is thus pulled from the end of the cable, the sheath and insulation are subjected to no undue strain and usually the total slack can be obtained in one pull.

Portable Automatic Substation Aids in Maintaining Service

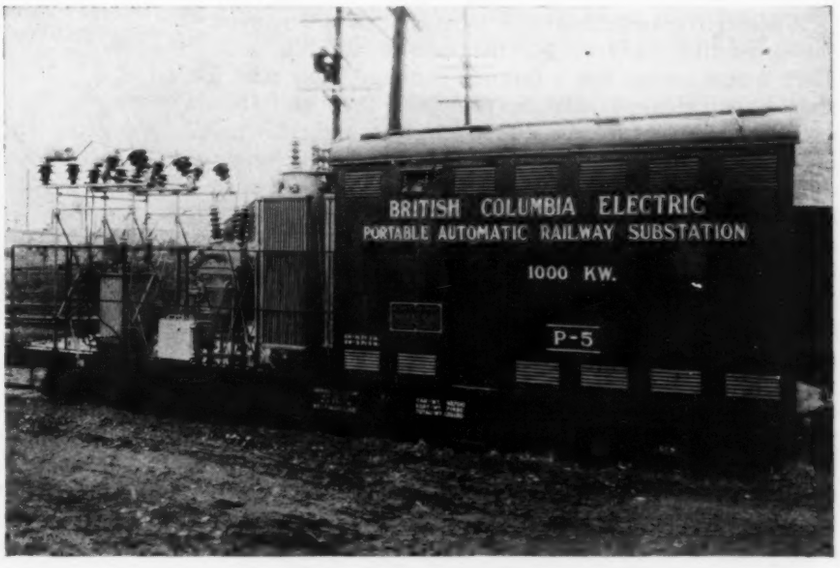
AN AUTOMATIC 1,000-kw. substation equipped with rotary converter, transformer, oil circuit breaker and feeder equipment has been mounted on a railway car and placed in service by the British Columbia Electric Railway. The portable substation is designed for use in emergencies or where there is a sudden increase in demand.

The equipment includes a 1,000-kw., 600-volt d.c., six-phase, 60-cycle rotary converter, a 1,100-kva., three-phase, self-cooled transformer, a motor-operated high-tension oil circuit breaker, a.c. and d.c. lightning arresters, gang-operated air-break switches and two service-restoring 1,100-amp. direct-current feeder equipments.

The apparatus is mounted on an all-steel car with converter and switchboard inclosed. The transformer, oil circuit breaker and all other high-tension apparatus of the outdoor type are mounted on the uncovered portion of the car.

The station is fully automatic, being started and stopped by load demand. Protection against low voltage, phase reversal, a.c. and d.c. overload, overheating of windings and bearings, reverse polarity, overspeed, phase unbalance, loss of field, etc., is provided. Connection to either a 11,500- or 34,500-volt line may be made. Feeders are automatic, reclosing upon condition of normal resistance in the feeder. Excess direct-current load actuates contacts of load-limiting resistances and shifts the load to other stations. Thermal relay action permits automatic restarting when high temperature conditions have been relieved by radiation.

The car is the joint product of the Ottawa Car Company and the Canadian Westinghouse Company, Ltd.

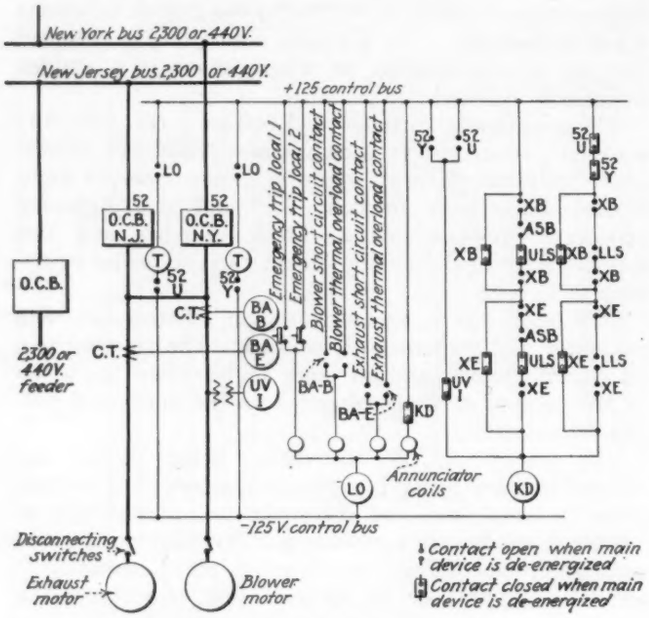


Railway supply substation has flat-car base

Complete Relay Protection for Fan Motors

By J. P. Maxwell
Switchboard Engineer
Westinghouse Electric & Manufacturing Company

MOTORS driving the blower and exhaust fans used in the Holland vehicular tunnel (New York-New Jersey) are provided with full protection against incorrect operation and emergencies. Large blowers and exhaust fans operate from 2,300-volt service, small ones from 440-volt buses.



Protective wiring plan for fan motors

ASB—Auxiliary speed relay for blower.
ASE—Auxiliary speed relay for exhaust.
LO—Multicontact lockout relay.
KD—Undervoltage time-delay relay.
BA—Short-circuit and thermal overload relay.
CT—Current transformer.
LLS—Lower limit switch on damper, closes when damper is closed.
T—Trip coil.
ULS—Upper limit switch on damper, closed when damper is open.
XB—Auxiliary switch on blower motor disconnecting switch.
XE—Auxiliary switch on exhaust motor disconnecting switch.
5Z—Oil circuit breaker.

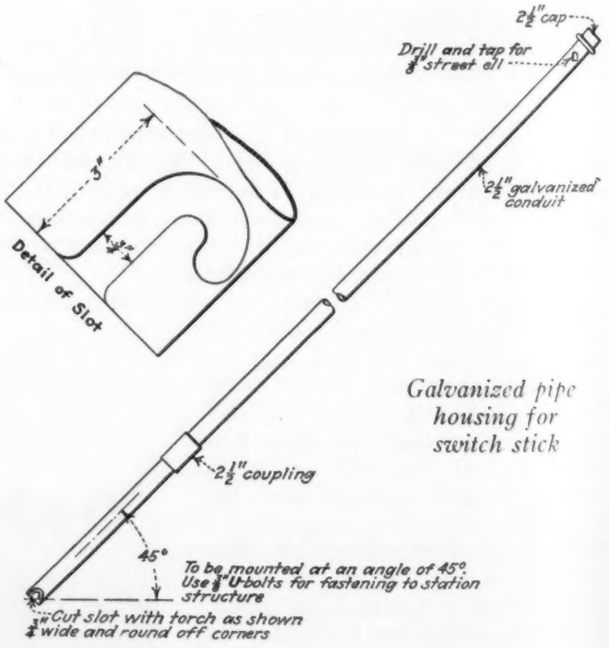
Whether the switchboard or local control is employed, the protective features for the motors are the same. Each motor circuit has a thermal overload relay with a short-circuit element. Besides protecting the motor from excessive temperature rise due to overload, the relay will operate if a short circuit occurs. To protect the motors during the starting and stopping period against failure of the speed-control devices and against the accidental closing of the dampers when the motors are running, a long time delay undervoltage relay has been supplied. This relay, known as Westinghouse type "KD," is continuously energized as shown on the diagram through one of the following circuits:

Through the auxiliary switch of either closed circuit breaker and a contact of a de-energized undervoltage relay; through the contacts on the auxiliary switch on the blower motor disconnecting switches (disconnecting switches being open); through the auxiliary switch on the blower motor disconnecting switches (disconnecting switch being closed); through the interlock on the auxiliary speed delay for the blower; through the upper limit switch on the damper when damper is closed, and similar circuits on the exhaust motor; through a circuit made by the contacts of both oil circuit breakers that are in the open position; through an auxiliary switch on both blower and exhaust motor disconnecting switches (switches being closed), and through the lower limit switch on the damper when the damper is closed.

All the protective relays used with the motors operate a multi-contact lockout relay. This lockout relay has several contacts, one of which changes the brilliancy of the white lamp on the control board from dim to bright, indicating an automatic operation, another of which energizes a bell alarm relay. These lockout relays are of the hand-reset type, and when once energized by the protective relay the operator must reset them before the oil circuit breaker can be reclosed. The protective relays, in addition to operating the lockout relay, also pick up an annunciator relay, Westinghouse type "JL," thus indicating which protective relay tripped out the motor breaker.

Switch-Stick Housing

OUTDOOR substations that include stick-operated disconnecting switches present a small problem on some properties. Shall a stick be kept at the station, perhaps hung up somewhere and exposed to the weather? Or shall it be the duty of the man who comes to operate the disconnecting switches to bring a stick along with him? Both of these answers are open to obvious criticism. On the system of the Kansas City Power & Light Company this difficulty is met by use of the device here illustrated. It consists merely of a piece of 2½-in. galvanized conduit capped at the top end and with the slot as shown in the accompanying illustration in the other end. The stick is pushed into the pipe, handle first, and the hook on the head is turned into the slot, thus preventing the stick from sliding out of the pipe. The pipe is mounted at an angle of 45 deg. wherever convenient on the station structure. The turned down ⅜-in. ell near the top of the pipe is to permit air circulation along the length of the stick and thus to prevent moisture condensation on it.


2½" cap
Drill and tap for ⅜" street ell
3"
¾"
Detail of Slot
2½" galvanized conduit
2½" coupling
45°
To be mounted at an angle of 45°. Use ⅝" U-bolts for fastening to station structure
¾" Cut slot with torch as shown ¾" wide and round off corners

Galvanized pipe housing for switch stick

Coal-Handling System of Buffalo Utility

By F. S. HELFTER

Junior Engineer Buffalo General Electric Company, Buffalo, N. Y.

"Rooster block" used in handling return cable when tail block car is placed for handling coal from points in storage yard farthest from winding engine

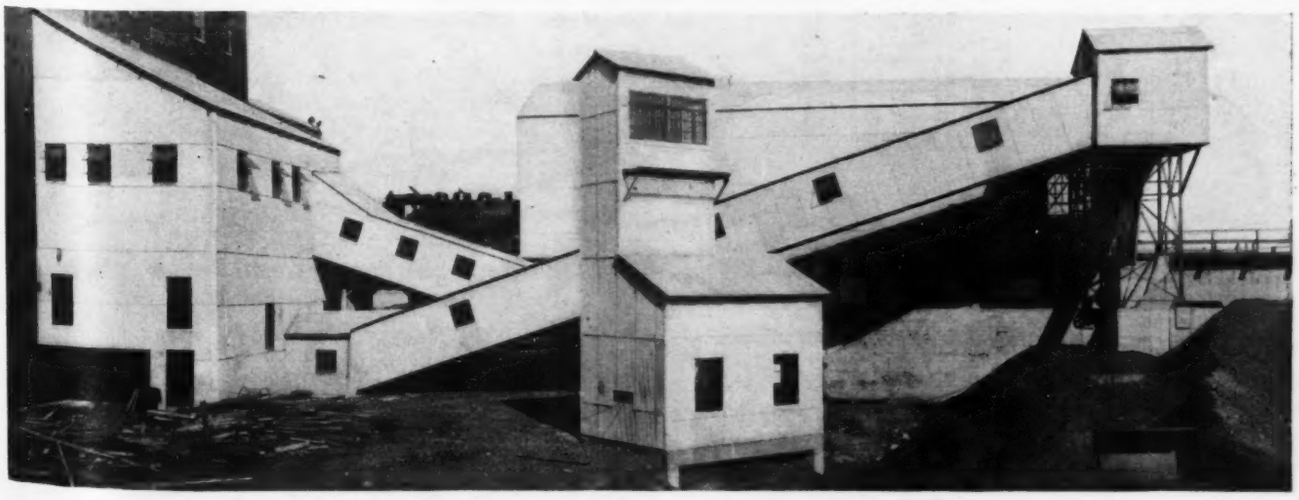
UP TO the present time at the Charles R. Huntley station coal to and from storage has been handled by grab buckets operated from locomotive cranes on trestles and tracks in the coal storage yard. With the installation of additional station capacity, which included coal pulverizing equipment, this system of coal handling has been found both inadequate and impractical. In the new arrangement two cars, after previously being weighed on a track scale, are dumped simultaneously into four concrete hoppers which are built into the existing trestle. A shaking feeder, having a rated capacity of 75 tons per hour, located at the mouth of each hopper feeds the coal onto a horizontal belt, *A*, which in turn discharges onto an inclined belt, *B*, delivering normally to a 12-ft. x 19-ft. Bradford breaker. However, depending upon the position of a flopper gate, the coal falling from the head end of this belt may be deflected in whole or in part through a chute directly onto another belt, *C*, delivering the uncrushed coal to the initial pile of the drag scraper system for yard storage.

The coal passing through the breaker falls on a short feeding belt that discharges through a flopper gate either onto a belt, *E*, delivering to the house, or onto the inclined belt, *C*, to the initial storage pile for the drag scraper, or if desired both ways at the same time. Normally, only run-of-mine coal is stored, but the equipment permits of similarly handling the crushed coal.

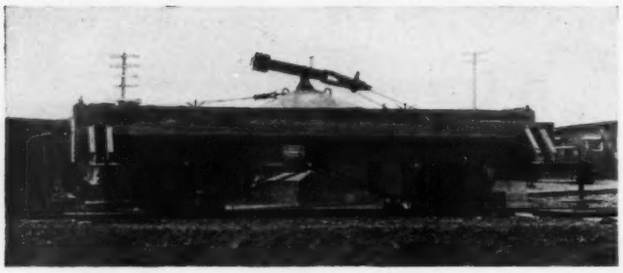
The belt into the house is equipped with a "Merrick" automatic conveyor weightometer. Its chief purpose is to keep track of all coal from storage which does not again pass over the track scales.

A cross-over belt is supplied to reach the far elevator. Magnetic separators are installed in the discharge chutes from the bucket elevators, where the coal drops onto the bunker belts, and automatic samplers are placed at this point.

All of the new equipment, with the exception of the Bradford breaker, is driven by double squirrel-cage induction motors with automatic cut-over type resistance starters and push-button control. On account of the high inertia of the coal breaker, a wound-rotor induction motor is used for this machine with a controller and starting resistance. All the controls are interlocked through auxiliary switches on the contactors and switches on the flop gates, so that if for any reason a conveyor or the breaker stops all equipment feeding coal to it also stops. If a gate is shifted to feed coal to a conveyor or the breaker when they are not running, this automatically shuts down all the equipment ahead of it. In starting up, if the coal is to be sent into the house the conveyors above the bunkers must be started first and the proper se-



Housings for conveyors, Bradford breaker and drag scraper, winding engine and controls



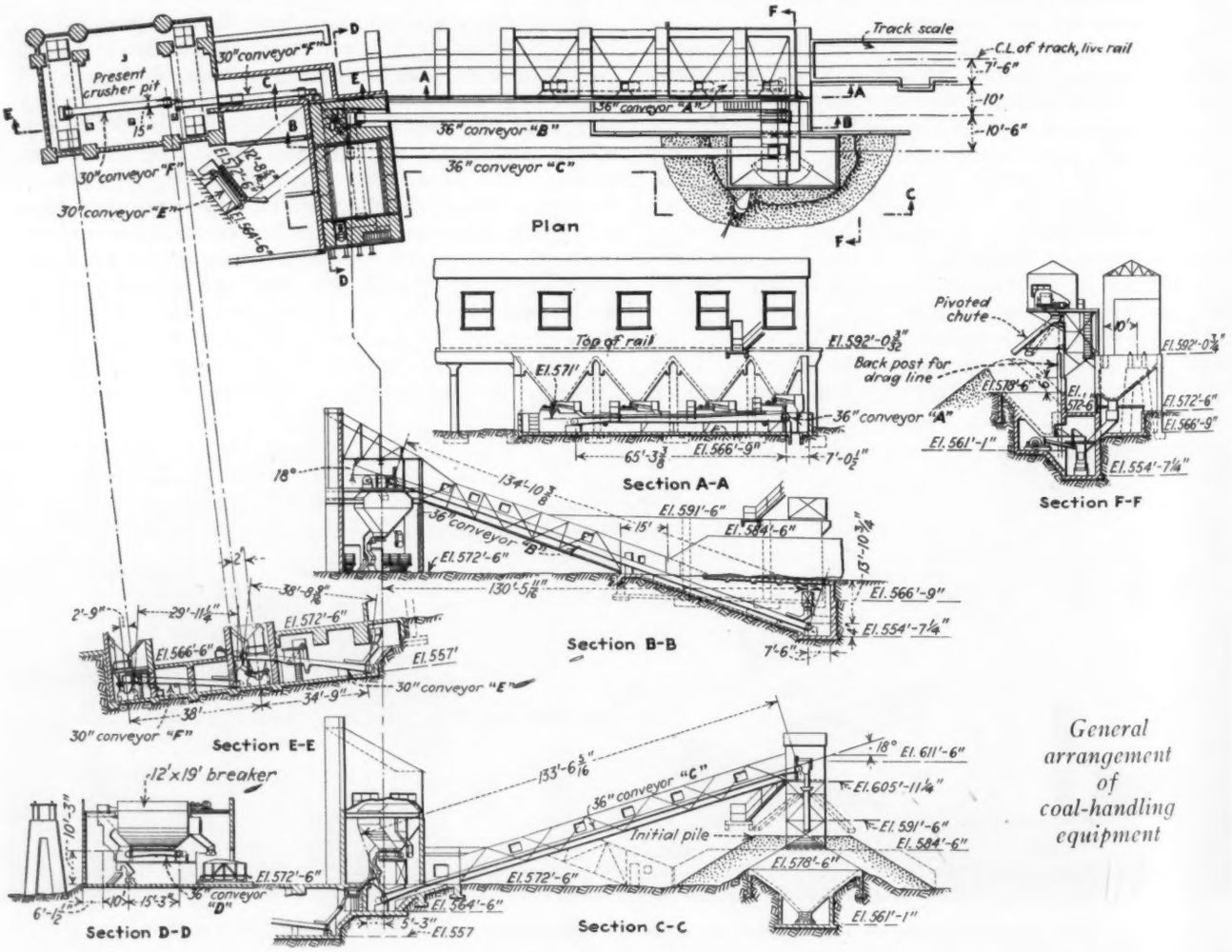
Tail block car used in distributing or reclaiming coal from any part of the storage yard

quence followed through to the feeders at the hoppers. In the storage yard the coal in the pile formed by conveyor *C* is distributed about the field by means of a Beaumont drag scraper in the center of one side of the storage area. Around the other three sides is a track on which the movable tail block car may be shifted by block and tackle as required. The tail car, counterweighted with concrete, weighs about 33 tons. In addition to this weight, rail clamps and outriggers are employed to keep the car from tipping. The coal is stored out, or reclaimed, by a scraper having a capacity of 2 tons, which plies back and forth between the front post and the tail car at the will of the operator. The machinery handles coal, either "run-of-mine" or crushed, at a rate of 225 tons per hour at 100 ft. haul. All that is necessary in order to change from storing out to reclaiming, or vice versa, is to reverse the scraper bucket on the cable. The cable after passing around the sheave on the tail car is kept from burying itself in the coal by passing through other fixed blocks (called rooster blocks) located at the corners of the field. One man can control this equipment. The operator's position is above the winding engine and at an elevation such that he has a clear view of the entire storage area. Operation is by a large wheel which controls the direction of rotation of the cable drums through a system of levers and cone friction clutches. A 100-hp. continuous-running squirrel-cage induction motor operates the scraper system. The capacity of the storage area with coal piled 25 ft. high is about 80,000 tons.

To facilitate the removal of frozen coal from the cars, a thawing shed has been provided which has a capacity of six coal cars. Some of the hot gases from either of two boilers are by-passed through this building by means of an auxiliary induced draft fan. Dampers are provided to control the temperature around the cars, and a recording thermometer shows how well this is being done. At a temperature of 200 deg. F. cars are sufficiently thawed in about four hours' time to permit the car gates to be opened.

Practically all of this equipment is external to the main building. Hoppers and trenches below ground are of concrete. The remaining structures are of steel with corrugated asbestos board roofs and siding. The breaker unit itself is inclosed in a sheet-steel dustproof case made up with removable panels.

The new equipment permits putting 300 tons per hour into the house and 500 tons per hour into storage.

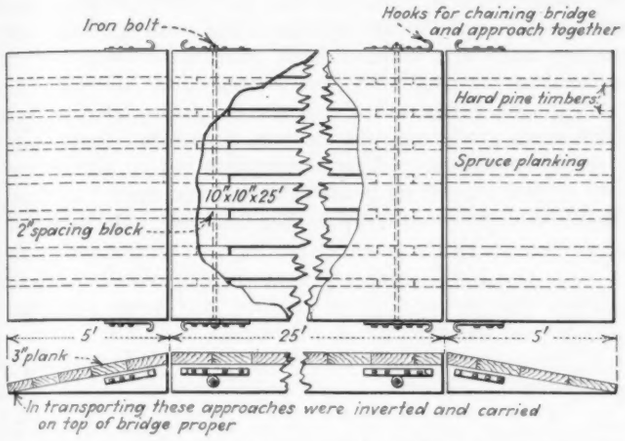


General arrangement of coal-handling equipment

Moving Transformers with a Portable Bridge

By R. G. Kennison
Central Maine Power Company, Augusta, Me.

FIVE power transformers aggregating 35,000 kva. in rating and 137 tons in weight were recently transported over a 13-mile route involving the crossing of eight streams, none of which was provided with bridges deemed safe for the loads to be handled. The problem was solved by building a portable reinforcing bridge



Portable reinforcing bridge enabled 34-ton transformers to pass safely over existing bridges

25 ft. long, with portable 5-ft. approaches for each end, as shown in the accompanying illustration. Three of the transformers were of 5,000-kva. rating, 66 kv. to 33 kv., and the two others were three-phase regulating transformers of 10,000 kva. each, the individual weights of the two types being 23 and 34 tons. The total cost of the job was about $500, including hire of tractors.

The transformers were transported one at a time on a Rogers 20-ton trailer hauled by one or more tractors. A 14-ton Lombard, 10-ton Holt and Caterpillar sixty tractor were used. The road conditions ranged from partially bare to glazed surface, with deep snow in some places. The ordinary procedure on the level was to hook one or two tractors ahead of the load, all three tractors being required on up-grades, especially if snow or ice was encountered. On down-grades, except on bare ground, it was necessary to hook one tractor on behind for snubbing, the ice and snow rendering the trailer brakes useless.

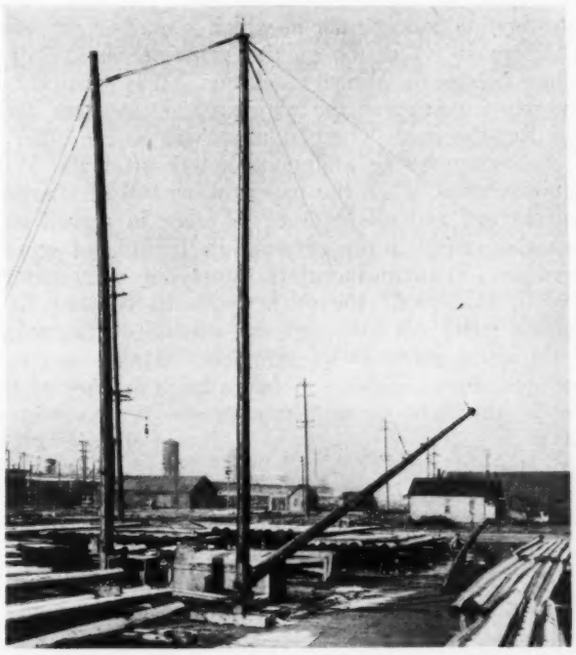
The transformers were shipped from the factory partly full of oil in order that the coils might be covered and to obviate the need of a heat run before being put in service. As all transformers exceeded 15 ft. in overall height the greatest care had to be taken to center them properly and to fasten them down to prevent tipping over.

The first process was to shore the transformers on the cars upon which they arrived from the factory. They were then moved on rolls from the cars to the trailer, where the shoes were bolted down by hook bolts under the flanges of the I-beams forming the trailer frame. The tops of the transformers were guyed four ways by 1-in. iron rods bolted to the flanges of the I-beams. This made it practically impossible to overturn a transformer without tipping over trailer and all. The shoe was 12 in. high and this, with the height of the trailer from the ground, brought the transformer top about 17 ft. into the air. This made it necessary for one man to devote his entire attention to the removal of wires, service loops and telephone loops encountered along the road. In most cases this was easily done by a man standing on a ladder against the transformer casing and using rubber gloves and a forked stick for pushing the wires up and out of the way.

The portable bridge consisted of eight 10-in. x 10-in. timbers 25 ft. long, fastened together and planked over as shown. This was used to reinforce each bridge in turn as the transformer passed over it. Seven of the bridges were of spans varying from 13 to 19 ft. The portable bridge gave a safe bearing at each end. One bridge was of 30-ft. span and in this case special precautions were taken. The bridge was shored up underneath with a crib pier near its center, and for reinforcement a second portable bridge was made and the two butted together so that the joint came over the new pier. Hardwood plank 3 in. thick would have scored less than spruce had the former been available for flooring at the time.

The portable bridge was transported by a truck equipped with a shear and winch. The winch cable was hooked via the shear to an eyebolt in the front of the portable bridge, and when it was necessary to move it along the road the front end was simply pulled up about 1 ft. from the ground by the winch and dragged along until the next bridge was encountered. The moving was usually done between 6:30 a.m. and 6:30 p.m., the return being made at night with the trailer. Loading was done by a night crew.

Pole-Yard Derrick Saves Time and Labor



A DERRICK used by the Northwestern Electric Company in its Portland (Ore.) pole yard is shown. The boom is 70 ft. long and is swung at a fixed angle by a tag line or by pushing the load. A motor-driven winch operates the whip line. Through the use of this derrick two men can load and unload and move poles about the yard with a great saving in time.

Government Investigation and the Investor

Investment banker has no apprehension of what investigation will disclose, but fears business and investment reaction

An Interview with
H. P. WRIGHT,
President Kansas Gas & Electric Company

"THE successful hunter goes where the ducks are before he begins to shoot. The fellow who goes out into the middle of the street, points his gun straight up in the air and blazes away because he has heard a rumor that there are some ducks around somewhere does not have duck for dinner. But he does attract a lot of attention. Maybe that was his idea all along. Of course, no one except the man who pulls the trigger can truthfully say whether or not he really hoped or expected to get a duck or whether he wanted the noise to awaken the neighbors. But one can form an opinion as to which is the true reason for all the shooting that's going on.

"So far as the properties in which I am interested are concerned, I am positive that any investigation of any kind will not turn up any flagrant moral derelictions in financing, management or in treatment of the customers who pay for service. I believe, also, that by far the greater number of electric utilities in the United States can say the same thing in full consciousness of rectitude and in perfect willingness to account for their every action. In these regards the so-called Walsh investigation which the Senate has committed to the Federal Trade Commission causes me no perturbation. But I do have a real fear that harm will result, not from any disclosures of the investigation, but from the animus of the investigation and manner in which it may be prosecuted.

"There is no doubt of the principal nature of the animus behind the Walsh resolution. It is political. The minority investigates the majority. Democrats investigate Republicans. The pendulum was on the other side of its swing during and immediately after the Wilson administration, when the papers were full of charges of malfeasance and misfeasance in office in regard to the disposition of alien property and to the inflated profits of patriotic (?) manufacturers supplying war materials. Investigations will always be with us so long as the political party not in power can depend on the strength of the vocal cords of its members. This is not to say that some investigations, in fact a large number of them, are not justifiable as well as natural. When an investigation is directed toward specific and definite charges against specific and definite persons or corporations, like the hunter who goes where the ducks are, then there is likelihood that the result will be of worthily corrective nature. But if an investigation, such as that sponsored by the Walsh resolution, has nothing to go on except vague and hazy accusations against the whole body of a national industry, then the result is foreordained to be more harmful than good.

MAY JEOPARDIZE INVESTORS' INTERESTS

"The result will be harmful to business in general and to the investing public, which in this day includes a not inconsiderable fraction of the total population of the country. Business will be harmed because the precedent will have been established that governmental prying into private concerns is gratuitous, that competent and specific evidence of wrongdoing is not required to get a federal investigation started; all that is required is for an industry to attain such success and prosperity as to make it a shining target for any one who feels the urge to throw a brick. If the electrical industry is investigated on these unpositive bases, as it appears that it will be, then another industry will be next, and so on. The result will be harmful to the investing public, which, through savings banks and insurance companies, includes a much larger number of people than is generally appreciated, because of the impairment of confidence in the values behind outstanding securities. It is very probable that the stocks and bonds of operating and holding companies that are haled before the commission will be quoted at lowered prices on the markets. It will make no difference whether charges are substantiated or even not made; the market reflects apparent, not always factual, conditions. The assumption is that the defendant is guilty until he proves himself innocent. And will the investigators surround the innocent and discharged defendant with the trumpet blaring and circumstance that accompany his summons before them? Well, every one knows that the accusation of vice gets more newspaper space than does the proof of virtue.

"For these reasons, and not because I fear that any considerable or even appreciable evidence of turpitude will be uncovered, I deplore the investigation and what it portends for American business in general.

ALREADY UNDER STATE SUPERVISION

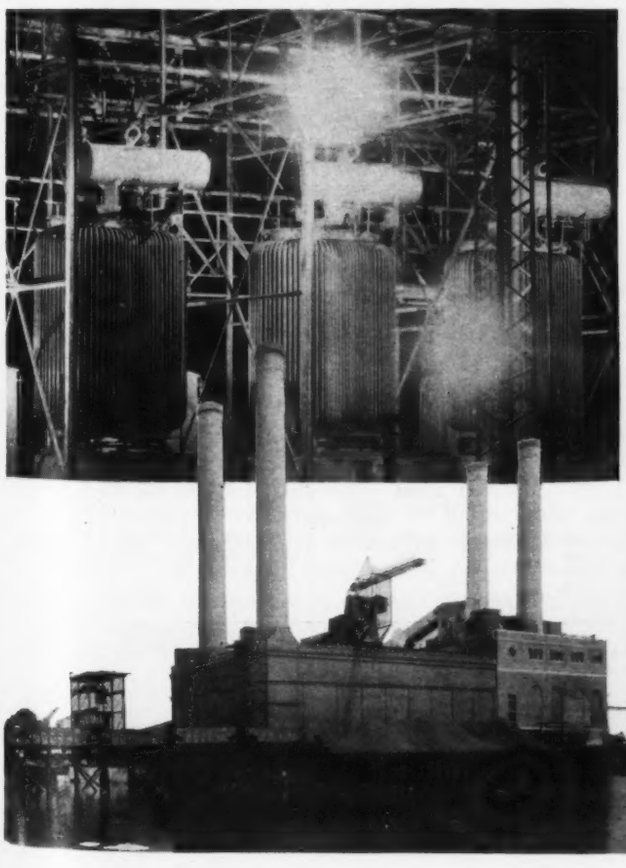
"Another thing occurs to me: What are the alleged nefarious acts of electric utility organizations that cause the coldly speculative eye of suspicion to swing in their direction? Are not these acts authorized and permitted by the laws of the states in which they are performed? A baseball game is started under rules fully understood by all the players. A runner gets to second base and some one begins yelling for an investigation as to how he got there, although the umpire said he was safe on first. Yes, he observed the rules as far as we know, but he must have spiked the first baseman or something. We'll investigate and find out if he did or did not do something wrong between the time he hit the ball and the time he touched second in spite of the umpire's ruling at first. We have no evidence that he did do anything wrong, but let's disorganize the game for as long as is required to have an investigation as to whether or not he did play square. A more reasonable course would be to let the player go on, let the game continue, while consideration is given to the rules and to amending them if necessary to make a fairer game hereafter. This is the situation in regard to the electric utilities. They have entered the game and have complied with the rules as laid down and the umpires have declared them safe all along the line. Instead of hindering their progress, governmental effort should be directed to considering the rules of the game. Most states have blue sky laws of one kind or another. All such laws are characterized by one thing, the requirement that securities and companies issuing securities must conform to certain stated conditions. These conditions satisfied, the sale of securities may proceed with the sanction of the state. The manner of satisfaction of these conditions is no one's concern. And sometimes on this account the blue sky law fails of its purpose to protect the investor and he suffers. Would it not be better if, instead of simply setting up conditions to be fulfilled before the sale of

securities, the blue sky laws should be made to be actually what they were intended to be, laws against fraud? Would they not be simpler and easier to enforce to their desired end? If any investor in light and power securities has suffered loss from the malicious acts of the issuing company would he not have the same recourse at law as if a counterfeit bill had been passed on him? If any user of electricity feels that the rates he pays are extortionate has he not recourse under the laws of his state?

"The rules and laws of electric utility regulation are everywhere in the United States set up in some kind of governmental, state or municipal supervision. They are the rules of the game and they have been scrupulously observed in ninety-nine cases out of a hundred by the utilities, else their securities could not have been issued and sold. If the game is not going fairly, let's get the rules fixed. We don't have to disorganize the game while we find out if the man on second base got there fairly or not. All that happens then is that the man who yells for the investigation gets a lot of attention from the grandstand."

Norfolk (Va.) Has $5,000,000 Station

THE Reeves Avenue power station of the Virginia Electric & Power Company is designed for an ultimate capacity of 90,000 kva. The recently completed 42,000-kw. section is shown in the accompanying illustrations. The converging-passage condenser is of the single-pass type and its 23 miles of tubes have a total cooling surface of 27,500 sq.ft. The Newton Park substation, indicated in the night view, is fed by four 1,000-volt, 300,000-circ.mil cables from the Reeves Avenue switch house.



Transmission Factor of Colored Media Influenced by Temperature

By M. Luckiesh
Director Lighting Research Laboratory, National Lamp Works of General Electric Company, Nela Park, Cleveland, Ohio

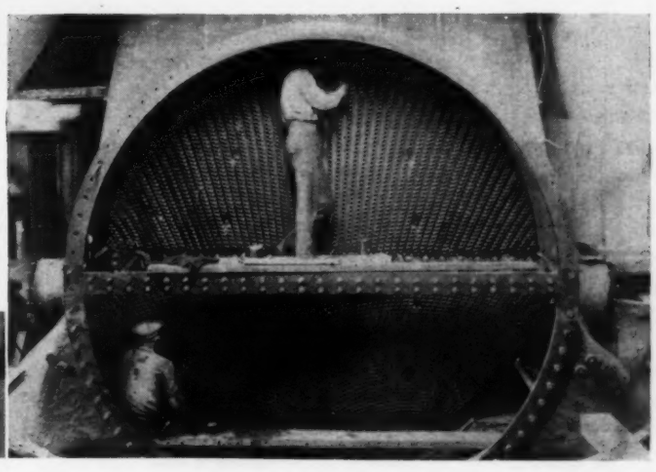
MANY years ago it was observed that the transmission factor of a deep red glass decreased with increasing temperature. Then ten commercial colored glasses were investigated and it was found that practically all of them changed in color and decreased in transmission factor when heated. However, it was found that certain blue glasses (containing cobalt) increased slightly when heated. A deep red glass (containing copper) at 660 deg. F. (350 deg. C.) transmitted only 42 per cent as much light as it did at room temperature, whereas the transmission factor of cobalt-blue glass increased 8 per cent for the same temperature change. Further work with colored gelatines and superficial coatings for lamps show that all of these colored media also change when heated. The color and transmission factor go back to normal when the medium is cooled, excepting, of course, the cases where fading has actually taken place under the action of the heat or light to which the specimen was subjected.

These results are of interest in connection with the photometry and use of colored coatings, colored-glass bulbs and colored accessories for tungsten lamps. When measuring the luminous outputs or transmission factors of colored lamps or colored accessories our practice is to permit them to reach a stable temperature before making the measurements. To illustrate the amount of change to be expected with commercial media some results are presented herewith on red, yellow, green and blue color caps which were used with a 150-watt tungsten lamp of the usual type.

Each unit was photometered in an integrating sphere at regular intervals until the luminous output became constant, which was at the end of about twenty minutes. At that time the transmission factors of the various color caps had changed by the amounts which are shown in the following:

	Per Cent			Per Cent
Red	Decreased 41		Green	Decreased 16
Yellow	Decreased 9		Blue	Increased 3

The change in color with temperatures encountered in practice is appreciable, but is not as important as the change in the transmission factor.



5,000,000 Kva. in Large Transformers Annually

ANNUAL installations by power companies of transformers rated at 3,000 kva. or larger range from about 100 to 500 kva. per 1,000 kva. of generator rating, according to data courteously furnished to the ELECTRICAL WORLD by nine prominent power companies. The returns here tabulated came from companies well diversified as to geographical situation, as to size and as to type of territory served; that is, congested urban or widely distributed, the latter demanding long transmission circuits. In generator rating they cover about a sixth of the industry. They are probably fairly representative of the upper 85 per cent of the industry, in terms of installed capacity, or 25,000,000 kva. Although 3,000 kva. was arbitrarily chosen as a lower limit, the table gives sufficient detail to permit of analysis with a higher starting point.

The approximate station rating at the end of 1926 of the companies contributing data was 5,154,000 kva. The new installations of large transformers add up to 1,262,672 kva. in 1926, 1,063,327 kva. in 1925 and 765,416 kva. in 1924. In comparing these totals of new large transformers installed during each year with the then existing generator rating allowance must be made for the annual growth of the latter. The average kilovolt-amperes of the former per thousand kilovolt-amperes of existing generators was 245 in 1926. In 1925 it may be taken roughly at 225, and in 1924 at 175, allowing for the annual change in generator rating.

As might be expected, there is a wide variation between companies and between transformer installations by the same company in different years. Type of territory seems to have little influence, high and low values coming equally from localized companies and from those serving large areas.

Averages are often an unsafe guide and inferences drawn from partial data must be used with caution. With these reservations, and assuming that the average of about 200 kva. of transformers per 1,000 kva. of generators derived from this sample may fairly be applied to the 25,000,000 kva. previously mentioned, a normal year ought to see about 5,000,000 kva. of large transformers installed by the electric power companies of the United States. This does not include installations by railways or manufacturers on their own account.

Electrically Operated Doors for Railroad Tunnel

EXTREMELY low temperatures, high air velocities and large quantities of moisture in the electrified Charnaduras tunnel of the Bernina Railway, Switzerland, led to continued difficulties with ice formation on tracks and contact conductors. In winter a large staff of men were employed for clearing these facilities. Electrically operated doors, opening and closing automatically, have recently been installed at each entrance. It is stated that the experiment has proved so successful, the temperature in the tunnel never falling below the freezing point, that installations of similar character are planned for use in other Swiss railway tunnels.

Annual Additions in Transformer Capacity (Units of 3,000 kva. or Larger) in Relation to Installed Generator Rating

Company	Approximate 1926 Station Rating, Kva.	Additions to Transformer Installation												Kva. Total Transformers Installed (1924-1926, Incl.)	Average Annual Kva. Transformers	Average Annual Transformer Kva. per 1,000 Kva. of Station Rating (1924-1926, Incl.)
		1923			1924			1925			1926			1927 (First Six Months)					
		No.	Size, Kva.	Total Kva.	No.	Size, Kva.	Total Kva.	No.	Size, Kva.	Total Kva.	No.	Size, Kva.	Total Kva.	No.	Size, Kva.	Total Kva.			
A	900,000	12	5,000	60,000	3	4,000	45,000	9	5,000	82,500	3	8,333	71,331	3	5,000	15,000	198,831	66,277	75
					3	6,000		3	12,000		3	6,000					(a) 213,831	(a) 61,095	70
					3	5,000					3	5,000							
											4	3,333							
B	850,000	..	.....	.....	2	7,500	70,000	3	2,500	211,166	1	3,600	122,598	7	3,000	36,000	403,764	134,588	160
					3	5,000		3	3,333		3	7,500		2	7,500		(a) 439,764	(a) 125,647	150
					2	20,000		4	5,000		3	10,500							
								4	7,500		6	10,833							
								6	10,500										
								1	14,000										
								1	66,667										
C	800,000	6	3,000	228,000	12	3,000	186,000	3	3,000	129,000	6	3,000	168,000	18	3,000	174,000	483,000	161,000	210
		6	5,000		12	5,000		12	5,000		9	5,000		6	5,000		(a) 961,000	(a) 240,250	250
		6	10,000		9	10,000		6	10,000		3	10,000		3	10,000		(b) 657,000	(b) 187,714	300
		6	20,000								3	25,000		3	20,000				
														(Last 6 months)					
														3	3,000	304,000			
														6	5,000				
														3	10,000				
														6	16,666				
														3	20,000				
														3	25,000				
														(12 mo.		1927, 478,000)			
D	725,000	..	.....	.....	5	4,000	28,500	6	4,000	141,500	1	4,000	121,500	6	6,000	43,000	291,500	97,167	135
					1	8,500		4	6,000		6	6,000		1	7,000		(a) 334,500	(a) 95,571	130
								11	8,500		8	7,000							
											3	8,500							
E	650,000	..	.....	.....	20	3,750	155,000	6	3,750	34,500	12	3,750	45,000	..	.....	.....	234,500	78,167	125
					4	20,000		3	4,000		12	20,000							
F	600,000	..	.....	.....	6	3,750	48,666	7	3,750	298,249	5	3,750	465,748	9	4,000	54,750	812,663	270,888	450
					2	3,333		10	11,500		7	4,000		5	3,750		(a) 867,413	(a) 247,832	400
					1	11,500		3	4,000		6	10,000							
					2	4,000		3	3,333		6	3,333							
								9	15,000		6	11,500							
											18	15,000							
G	375,000	..	.....	.....	8	10,000	80,000	14	3,333	116,662	15	3,333	211,995	2	3,000	6,000	408,657	136,219	360
								7	10,000		2	6,000					(a) 414,657	(a) 118,473	310
											13	10,000							
											1	20,000							
H	160,000	..	.....	.....	17	.....	155,250	4	.....	49,750	3	.....	32,500	..	.....	.....	237,500	79,167	490
I	90,000	..	.....	.....	.	.....	.....	..	.....	.....	3	8,000	24,000	..	.....	.....	24,000	8,000	90

(a) Including 1927. (b) Including first six months of 1927.

Quality Industrial Lighting*

Glare a serious factor in manufacturing output considerations. Illumination standards offer basis for analysis of existing conditions. Comparative data indicate value of plan

By Arthur A. Brainerd
Philadelphia Electric Company, Philadelphia, Pa.

THE effect of glare, both direct and reflected, on production is a very serious item in many manufacturing operations. Direct glare from bare "Mazda" C lamps on drop cords is, of course, a very common occurrence. An illustration of such a condition is offered in Fig. 1, which shows the appearance of the infants' hosiery division of the Reid Hosiery Company. The improvement indicated in Fig. 2 was secured largely during a correction of glare values. In this case removal of direct glare resulted in a decrease in labor turnover from 43 per cent per month to almost nothing. Direct glare from poorly planned systems of RLM units had also resulted in many complaints. This became so serious in the case of Jacquard looms that it finally became necessary to cover the openings of the reflectors with a diffusing cover glass before the union officials would allow a change in lighting.

The reduction of reflected glare to a low value undoubtedly had much to do with the increase in speed of production in the machine shop of the American Metal Works. The same is true to an even greater degree in the Decorative Lamp & Shade Company's woodworking shop, and the B. Wilmsen Company. In all these cases great care was taken to reduce this glare to a minimum.

The tests here recounted were of such a nature that it was impossible to separate the variable quantities. General observations throughout the tests, however, indicate that the measurement of reflected glare and its influence on productive operations would make a very profitable subject for future research studies.

There is also reason to believe that the present open type of steel reflectors introduces a high degree of both direct and reflected glare, especially when extremely high intensities are used.

Localized general lighting becomes almost out of the question in many cases when lamps of 200 watts or larger are used in connection with RLM domes or "Glassteel" diffusers. In the case of the Sidebotham mills, however, where we are at present experimenting with foot-candle intensities varying from 40 to 50, the operators experience no discomfort, since the illumination is totally indirect. In fact, they are enthusiastic over the arrangements. In the same location the glare from "Glassteel" diffusers becomes very annoying at 20 foot-candles. Illumination intensities of the order given above could hardly be used in a room with such low ceiling height with open reflectors.

There seems to be no question that before we can profitably carry industrial illumination to intensities of 30 foot-candles or over there must be developed some new form of lighting units that will retain the efficiency and rugged character of the RLM dome and still have much better diffusing qualities.

Figs. 1 and 2—Before and after views in mill manufacturing infants' hosiery
Correction of glare conditions in this plant practically eliminated a labor turnover of 43 per cent per month. At the same time the output was increased 6.25 per cent.

The second and final part of an abstract of Mr. Brainerd's paper "Quality Measurements in Industrial Lighting Calculations," which received the James H. McGraw N.E.L.A. award for merit. The first installment appeared in the Feb. 4, 1928, issue of "Electrical World" and outlined the basic problems of industrial illumination.

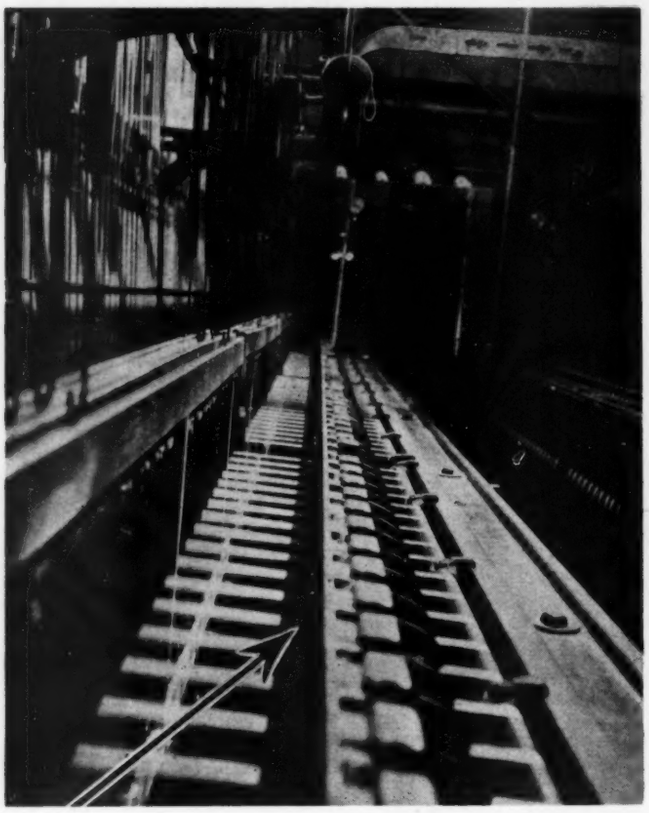
The purpose of this discussion is not intended to discount the value of adequate illumination intensity, but merely to call attention to the fact that intensity is only one of several things to be considered. The accompanying curves show the effect of increasing the intensity of illumination both on over-all production and speed of handwork. In the case of the American Metal Works the remarkable rise in the speed of handwork is probably due to the fact that there were no facilities available to determine accurately the percentage of handwork that depended upon manual skill and not on seeing. It will be noted that in both cases both the over-all increase in production and the increase in speed of handwork closely follow Fechner's law.

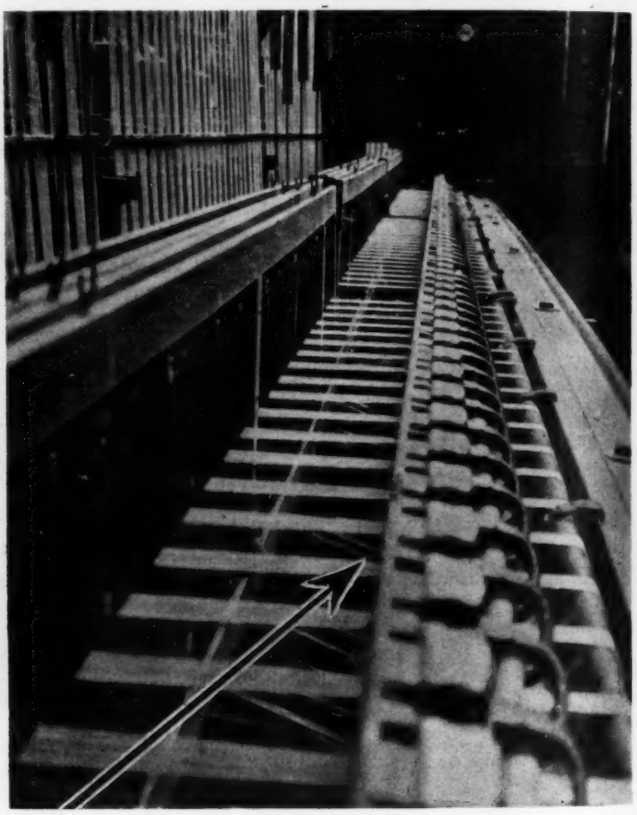
There is no doubt that the prevailing illumination intensities of 1 to 5 foot-candles are ridiculously low. They must be raised appreciably before production can attain its maximum, but proper attention must first be given to improving the quality of the illumination.

On the other hand, a series of studies conducted at the John Sidebotham plant (see Figs. 3 and 4 above) covering a period of nearly two years seemed to indicate that there was no justification from the production standpoint for using illumination intensities higher than 12 to 20 foot-candles. Five different levels of illumination—8, 12, 20, 30 and 40 foot-candles—were used in this test, and as the system was totally indirect, the items of glare and shadow were eliminated entirely.

Value of Product and Production.—In laying out a system of productive illumination we must never lose sight of the fact that money spent for good lighting is to be considered as an investment rather than an overhead expense, and the amount of profit made in a given area in a given space of time will determine to a certain extent the amount of money that can profitably be invested in lighting. Consulting the tabulation, it is quite evident that a manufacturer of high-grade silk hosiery can consistently spend far more money for illumination than a manufacturer of cheap dress goods. In one case investigated, the Shen Manufacturing Company, a preliminary test indicated a possible increase of 15 per cent in production at an increased operating cost equivalent to 12.65 per cent of the payroll. Such an investment would be a business venture of doubtful value and it would be futile to recommend any such course of action.

In view of these facts it would seem reasonable to establish a certain percentage of the payroll as a maximum that could safely be invested in good lighting under standardized conditions. To be sure, a large percentage of the plants today are operating on some sort of a piece-rate basis, but the benefit of having a contented force of workers who are easily supervised is a real item to be considered, not to mention the reduction in overhead which an increase in production always brings about.





Figs. 3 and 4—Tape loom before and after installation of good lighting

Eliminating the sharp shadows, indicated by the arrow in Fig. 3, increased production 7.7 per cent, although the illumination intensity was increased only 1.1 foot-candles. Later the illumination intensity was increased to 12, 20, 30 and 40 foot-candles, but no increase in output was noted above 12.

Height and Spacing.—In determining height and spacing it is quite evident that as far as increase in production and decrease in spoilage are concerned the working area alone is to be considered and an average room intensity in any plant is meaningless. If we mount overhead units in such a position as properly to illuminate machine tools to a 20 foot-candle intensity throughout the working area, which may be a circle 4 ft. or more in diameter, it is quite obvious that there will be sufficient illumination in the aisles. Such an intensity will provide sufficient

illumination for reading micrometers and steel scales. As long as the worker does not normally lift his eyes outside of the high-intensity area, it is clear that a high foot-candle value in the passageways is useless. Mounting height of 8 ft. will be found sufficient when outlets are equipped with 150-watt bowl enameled lamps in RLM domes.

Method of Predicting Production Increases.—Our present knowledge of the application of light to manufacturing operations is far from complete and in many cases we are obliged to depend more on personal judgment than on any definite method of analysis when we prepare plans for productive lighting. There is a wealth of excellent lighting equipment on the market the possibilities of which we have failed to make use of. Moreover, when selling good lighting to industrial executives, we talk increased production, but when pinned down to facts we cannot predict with any degree of assurance just what good lighting will do in any particular industry.

For the purpose, therefore, of reducing lighting recommendations to a more exact basis, even though the method is far from being scientifically accurate, it may be well worth while to set up some sort of empirical formulas that will best harmonize with the results secured in the investigations under consideration. First let us list separately each item that affects the character of the lighting installation and assign to each an arbitrary value.

Experience has shown that sales of better lighting may be divided into three distinct classes.

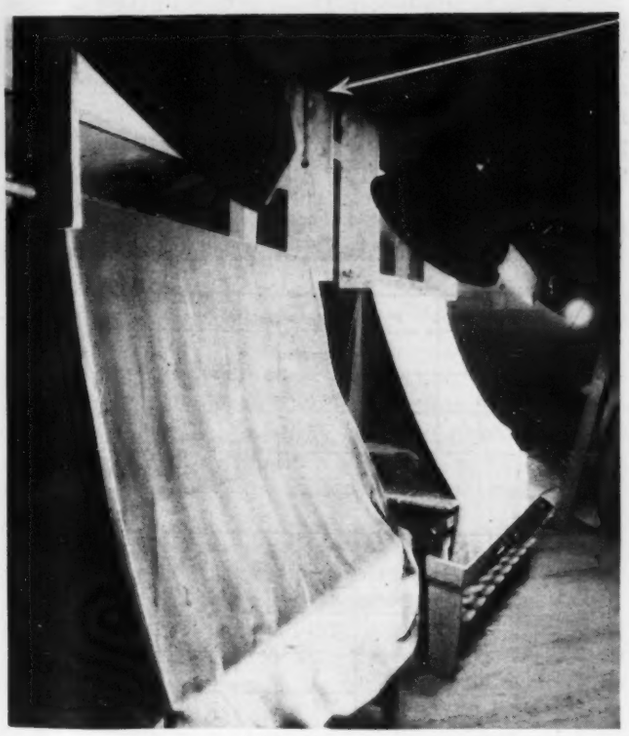
1. The customer has fair illumination and wishes to install the best that can be had.
2. The present installation is bad and the customer will consider only fair illumination.
3. The present installation is very bad and the customer wishes the best illumination.

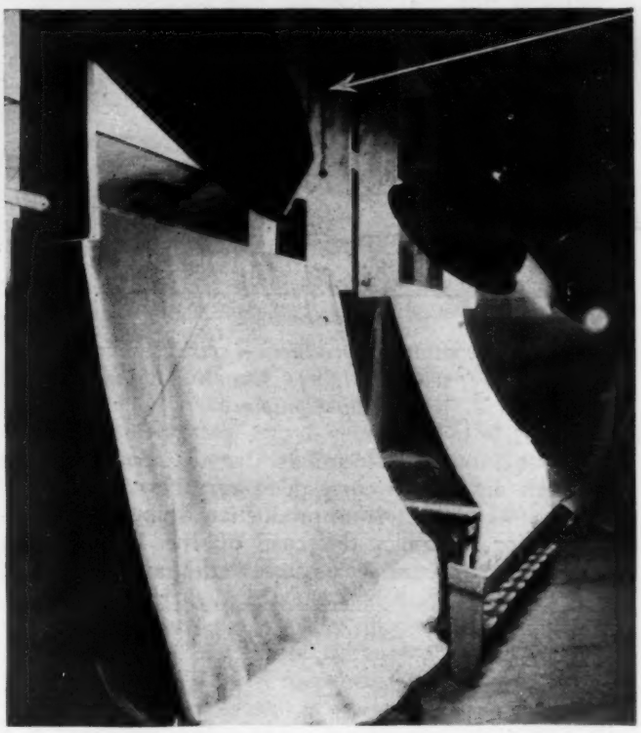
For purposes of estimation let us assume that fair illumination will produce approximately one-half the increase in speed of handwork that can be secured when the lighting has been brought to the very highest standard that our present-day knowledge of lighting affords.

The factors that determine the degree to which speed of handwork is influenced by illumination are variation factor, density of shadows, reflection characteristics of the surface, background contrast, visual angle of objects viewed and amount and character of natural illumination.

If the existing system of lighting is bad, let us assume that if the variation factor is over 3, fair lighting by reducing this factor will increase speed of hand operations 5 per cent and excellent lighting 10 per cent.

If, on the other hand, the variation factor lies between 2.25 and 3, fair illumination would effect no increase in speed and excellent illumination only 5 per cent increase. When this factor is below 2.25, no appreciable increase in production is to be expected by reducing it, except under extreme conditions.





Figs. 5 and 6—Inspection perch in plush mill

Replacing clear lamps with bowl enameled increased production 42 per cent with only 25 per cent increase in foot-candle intensity. Note softness of shadows as indicated by arrow in Fig. 6.

In order that we may have some specific standards for use in our calculations, poor, fair and excellent illumination are defined as follows:

Visual angle above 3	
Bad	Below 3 foot-candles
Fair	3–7 foot-candles
Excellent	Above 7 foot-candles
Visual angle 1.1 to 3	
Bad	Below 5 foot-candles
Fair	4–9 foot-candles
Excellent	Above 9 foot-candles
Visual angle below 1.1	
Bad	Below 7 foot-candles
Fair	7–14 foot-candles
Excellent	Above 14 foot-candles

No installation of bare lamps less than 16 ft. from the floor is considered good illumination. When the walls and ceiling are exceptionally light experience shows that the net effect on night operation is equivalent to fair natural illumination.

Referring to Table II, page 251, Feb. 4, 1928, ELECTRICAL WORLD, it will be noted that all factors referred to have been assigned arbitrary constants, corresponding to the different conditions under consideration. No claim is made for the absolute accuracy of these con-

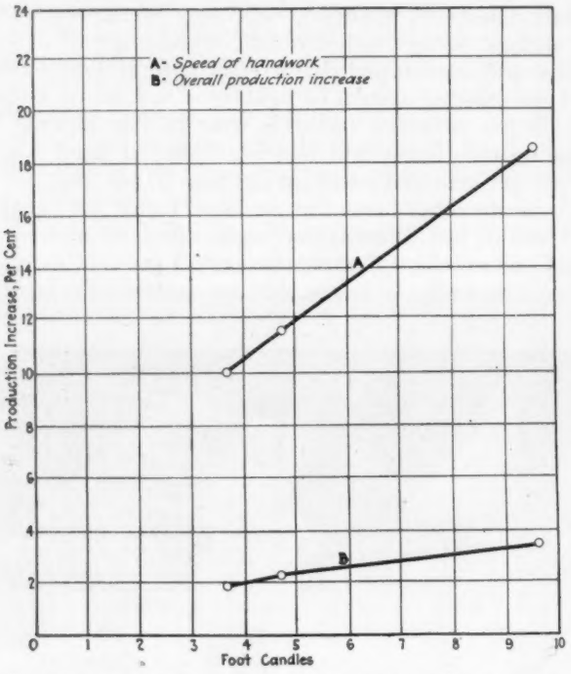


Fig. 7—Variation of production with illumination intensity; webbing looms Manning J. Smith Belting Company

stants, but it must be recognized that the results secured from their application correspond very closely with the actual results secured from production tests.

Take, for example, the case of the Realart Silk Hosiery Company, and let us analyze the case as follows:

Old illumination	Fair (7.2 foot-candles)
New illumination	Excellent
Variation factor	2.2, add 0 per cent
Shadows	Dense, add 5 per cent
Reflections	Specular, add 5 per cent
Background contrast	33 per cent, add 5 per cent
Visual angle	0.532, add 4 per cent
Natural illumination	Fair, add 5 per cent
Total estimated increase in speed of handwork production	24 per cent

Substituting in the equation previously given,* we have

$$\left(\frac{M_2 m_1}{M_1 m_2} - 1\right) \times 100 = 24$$

$$\left(\frac{M_2 \times 26.8}{73.2 \times m_2} - 1\right) \times 100 = 24$$

$$\frac{M_2}{m_2} = 3.39$$

$$M_2 - 3.39 m_2 = O, \text{ and } M_2 + m_2 = 100$$

Solving, $M_2 = 77.1$ and $m_2 = 22.9$

Estimated increase in production

$$\frac{77.1 - 73.2}{73.2} \times 100 = 5.33$$

This system of analysis was first applied in one case, before the old system of illumination was changed, in an effort to determine whether or not the conditions justified the expense of a test. With the constants then in use an increase in production of 6 per cent was estimated. Actual increase in production, according to factory records, was 5.75.

For daytime operation the above estimate for increase in speed of handwork would be 5 per cent lower, since the natural illumination is fair and the shadows medium.

If the original illumination had been bad from the standpoint of intensity, all of the constants except that for shadows would have been doubled. Experience shows that a mere softening of shadows may be expected to bring about soon an increase in speed of handwork of the order of 7.5 per cent.

Two other checks on the accuracy of the system were made before the present series of constants was completed. One was the case of the Sidebotham mills, where 7.5 per cent increase in production was predicted and the test showed 7.7 per cent. The other case was that of the M. J. Smith Company, where 5 per cent was predicted and 3.74 per cent measured.

The results attained in applying this method to seven installations were indicated in Table II (ELECTRICAL WORLD, Feb. 4, 1928, p. 251). Using the arbitrary standards, it will be seen that of these fourteen cases the estimate was low in seven and high in seven. The average percentage of error is +6.66 for the fourteen cases studied.

The range of error in all but two cases is within reasonable bounds in view of the large number of variables involved. In the case of the M. J. Smith Company the

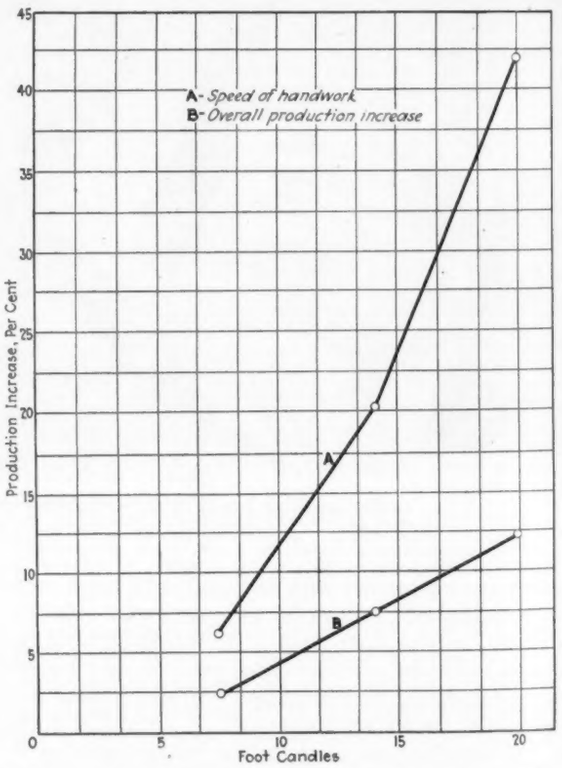
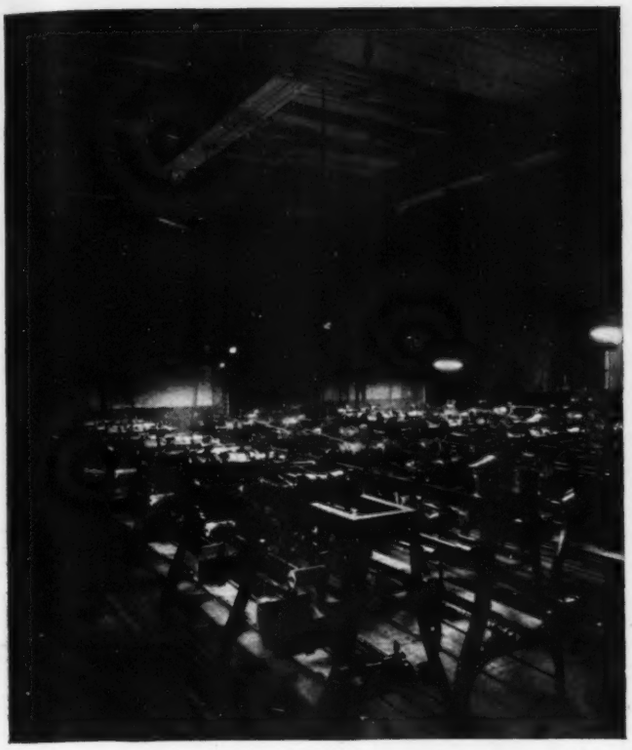


Fig. 8—Variation of production with illumination intensity; turret lathe American Metal Works

error in percentage seems large, but the over-all increase in production in this case is so small that the chances of error were unusually great in spite of all precautions taken in securing accurate data. This method of analysis, however, would have quickly shown the lighting engineer that production increase should not be stressed in attempting to sell better lighting in this instance.

In the case of the John Sidebotham mills, it is probable

*ELECTRICAL WORLD, page 249, Feb. 4, 1928.



Figs. 9 and 10—Before and after views of wire drawing machines in plant manufacturing Christmas tree tinsel
Note extreme glare conditions under old system. Good lighting increased the output of this plant 16 per cent.

that the indirect system of illumination would by its superior quality increase production to a much greater degree than the same intensity of direct lighting. Since no other installation of indirect illumination was available for comparison, there was no basis for making this allowance.

In general this method of calculation has proved quite valuable in practice and where records for checking are available the error is practically always less than 25 per cent. An experienced lighting engineer by exercising personal judgment in the use of the constants can in most cases arrive at an even closer estimate than a rigid use of the system will give.

The ultimate aim of all such research is to classify industrial lighting conditions so definitely that a lighting engineer will be able to approach a factory executive with sufficient information at hand to enable him to predict, within a reasonable percentage of error, the economic saving that can be expected from a scientific lighting system.

However much we may talk of improved morale, decreased labor turnover and decreased accidents, increase in production is the most powerful argument for better lighting that we can put forward and one of the easiest to demonstrate by actual test.

From the data recorded in this paper it is evident that in the design of industrial lighting such items as variation, factor, shadows, reflection, background contrast, visual angle and natural illumination are fully as important as mere foot-candle intensity, and probably more important. Instead of leaving these items to mere personal judgment, some method should be developed that will enable us to allow for these features quantitatively.

The method of estimation here described is intended only for an approximation. In many cases it has been possible to arrive at a fairly accurate value for the portion factor, shadows, reflection, background contrast, speed of vision and not solely on manual skill. No attempt has been made, however, to separate visual acuity and ability to sustain speed of vision. The remarkable increase in speed of handwork noted in some machine operations was undoubtedly due in part to the fact that the eyes were required to work only for a small portion of the time.

All the factors considered in the empirical method of prediction are capable of exact measurement, but it will probably be several years before this research is completed. Dr. Ferree and Dr. Rand have already measured the variation of speed of vision with different visual angles and background contrasts.

A complete analysis of these items will no doubt result in a much more accurate method of calculation. Since considerable time may elapse before such research is completed, this system is offered as a possible method of at once placing such estimates on a definite basis and also as a step toward some final formula for predetermining the increase in production to be derived from good illumination.

Microphone Control of Traffic Lights

THE city of Baltimore has recently placed in service a trial installation of motorist-controlled traffic lights. The signal light is said to solve satisfactorily the twofold problem of safeguarding and facilitating the traffic movement, an accomplishment which automatic signals operating at definite predetermined time intervals fail to do.

The development is particularly adapted to duty at the intersection of a busy highway with a road of relatively low traffic density. A three-color, red, green and yellow system is used. The normal indication for traffic on the main road is green and on the side road red. These signals remain constant until an automobile approaches the intersection from the side road. A micro-

phone is located in advance of the crossing on the side road on each side of the main highway. The motorist, forced to slow down by the red signal, passes the microphone at low speed and in doing so sounds his horn to clear the signal. This sets a time relay in operation, causing the signal to change successively from red to yellow and to green, with inverse indications for the main highway. The green signal is held automatically for a predetermined number of seconds and the system is then returned to its original indication by relay actions.

Utility Finances House Wiring for Contractors

SOME FIFTY electrical contractors in St. Louis have taken advantage of the Union Electric Light & Power Company's offer to finance house-wiring contracts and thereby assisted in bringing electric service to unwired houses. Under this co-operative arrangement, the electrical contractor may install wiring and fixtures in houses already built, and, upon satisfactory completion of the work, obtain prompt payment from the company, which, in turn, will collect from the purchaser in monthly payments. This agreement covers the installation of wiring and fixtures in homes already built or the installation of additional wiring and fixtures, but, so far, does not cover fixture work only.

The plan operates as follows: Upon developing a prospect for wiring and fixture work, the contractor forwards to the company's office a service and credit inquiry form completely filled out with the necessary information as to the purchaser's location, nature and cost of work, credit data and so forth. The company immediately investigates and notifies the contractor as soon as credit and availability of service have been established. This is usually completed within 24 hours after receipt of the inquiry from the contractor.

Upon completion of wiring and fixture installation, and after such work has been inspected and approved by the municipal authorities, the contractor sends to the company's office:

(a) Contract for the wiring and fixtures completely filled out in ink and signed by the purchaser and the contractor.

(b) Initial payment of at least one-twelfth of the face value of the contract.

(c) Contractor's bill for work made out for the face value of the contract, less 8 per cent.

If the contractor desires that his money be forwarded by mail, an assignment of claims for payment on the back of the contract is signed by him prior to forwarding the contract to the company's office. The contractor, however, does not secure the purchaser's signature to the order for financing the payment which is on the back of the contract, but a representative of the company secures this signature after the contract has been turned over to the company and the work has been completed to the customer's satisfaction. Contracts are approved for payment to the contractor after the purchaser's signature to the order for financing payment and the approval of the municipal authorities have been checked.

As will be seen from the conditions of the plan, the Union Electric Light & Power Company makes a charge of only 8 per cent to cover its bookkeeping, inspection,

UNION ELECTRIC LIGHT & POWER CO.
12TH & LOCUST STREETS
ST. LOUIS, MO.

House-Wiring Service and Credit Information Provided Utility by Contractors*

Address of premises to be wired; nature of premises (house, flat or apartment); number of customers in the building to be served; and number of sockets to be installed.

If special electric equipment such as electric range is to be installed, a notation is made under remarks.

CREDIT DATA

Total cost of wiring and fixtures ($); full name of person who will sign wiring order; this person's telephone number; is above person owner of premises; address of other property owned by above; to what address should bills be mailed; whether applicant is using or has used electric service and where.

If above person is not owner of the premises, the following information is also given: Occupation, place of employment; references (names and addresses of two parties now extending credit); name and address of owner of the premises; name of contractor; address of contractor; and contractor's telephone.

*Furnished on 8½ x 11 form with blanks for filling in.

Information Given and Requested by Distribution Department on Availability of Service*

Address (floor); name; nature of premises; telephone.

INFORMATION WANTED

Is service available for . . . ; consumer waiting? (yes or no); signature; date; and time.

Information received (date and time).

ELECTRICAL DISTRIBUTION DEPARTMENT DATA

Consumer at above location? (yes or no); name; load; city inspection; city permits; meter out; extension; lateral; space; necessary to send out; on extension for; contract in for.

Signature; date, and time.

*4 x 8½ form with blanks for information.

Outline of Credit Inquiry Sent to Accounting Department for Report*

UNION ELECTRIC LIGHT & POWER CO.

CREDIT INQUIRY

Address to be wired; nature of premises; amount of wiring and fixture; work to be financed ($); name (owner or tenant); address; telephone; will service account be in above name (yes or no); other property owned, occupation; place of employment; whether applicant has used or is using service and where.

REFERENCES

Parties now extending credit (names and addresses).

CREDIT DEPARTMENT REPORT

Remarks; signature; date and time.

*Printed on 4 x 8½ slip with blanks for filling in.

Nature of Notice Sent to Contractor to Proceed to Wire*

UNION ELECTRIC LIGHT & POWER CO.

Replying to your inquiry of . . . as to availability of electric service for . . . kw. at premises . . . street and approval of credit in amount $ . . . for electric wiring and fixtures to be installed in above premises under a contract to be signed by . . . you are advised as follows: . . .

Note:—In cases where service is available and credit is approved, we will accept order for financing of wiring and fixture installation during duration of House Wiring Campaign.

Such order will not be accepted: (1) in locations where electric service is not available; or (2) in cases in which credit is not approved; or (3) when order is received by us after close of House Wiring Campaign.

*Printed on 8½ x 11 sheet with sufficient space where blanks are indicated for filling in.

collection and other carrying costs. The six features of the contract are:

Contractor shall install outlets for connection of electric service and meter loop for installation of meter at points approved by Union Electric Light & Power Company.

Purchaser agrees that the cutting of walls, floors, baseboard, etc., is a necessary part of the work to be performed under this agreement, and contractor shall be responsible only for unnecessary damage to buildings or decorations.

Purchaser shall locate all outlets before installation hereunder is started, and contractor shall not be required to change location of outlets or fixtures after the work is started.

Purchaser agrees that failure to meet any payment, when due, shall render the installment feature hereof void, and the remaining balance shall become due and payable immediately.

In consideration of company advancing payment due contractor by purchaser for installation made upon above premises, purchaser agrees to contract for and use, or to have tenants contract for and use, the electric service of the company in the premises covered by this order for at least one year and until all payments to company as herein provided shall have been made.

It is agreed by purchaser that, in accepting this order for financing payment to contractor, company assumes no responsibility or liability for the performance or lack of performance by contractor of his obligations under the aforementioned contract for installation of wiring and fixtures, and purchaser agrees to hold the company harmless for all damages due to defective work or material or other causes resulting from performance of contractor's obligations.

Note: The form for electric wiring and fixtures carries thereon an order for financing payment, which is signed by the purchaser, and an assignment of claims for payment, which is signed by the contractor.

Commercial Lighting Yields Largest Return on Cambridge Rate

THE rate base of the Cambridge (Mass.) Electric Light Company computed on 1926 operations and determined on the reproduction-cost-less-depreciation theory is $8,035,469, according to recent testimony of Edward J. Cheney, New York, consulting engineer for the company in its recent rate case before the Massachusetts Department of Public Utilities. During that year the company sold 53,675,929 kw.-hr., of which 14,115,232 kw.-hr. was for metered lighting service and 34,576,077 kw.-hr. for general power uses. About 150,000 persons reside in the territory supplied by the company either directly or at wholesale. The accompanying table gives the revenue, allocated expense and amount of return on each class of business during the year above named. The total amount available for return, surplus and contingencies was 8.274 per cent of the rate base. In the determination of the rate base, the total physical property value was found to be $6,210,469; organization, $275,000; going concern value, $1,100,000, and working capital, $450,000.

RETURN AND COST TO SERVE CAMBRIDGE BUSINESS DATA FOR YEAR 1926

Class of Service	Rate Base 12/31/26	Revenue	Allocated Expense	Amount for Return	Percentage Return on Rate Base
Residential lighting	$2,224,175	$510,811	$365,368	$145,443	6.539
Commercial lighting	1,451,349	487,631	238,154	249,447	17.189
Domestic and commercial refrigerating and cooking	68,151	13,890	11,140	2,840	4.167
Primary lighting Belmont and Harvard University	575,124	73,114	84,970	*11,856	*2.061
Power	2,853,558	818,506	565,153	253,353	8.878
Municipal street lighting	863,112	120,335	103,050	17,285	2.003
Totals	$8,035,469	2,024,377	1,367,835	656,542	8.170
Adjustment for miscellaneous income	.....	.....	.....	8,306	.....
Total amount available for return, surplus and contingencies	.....	.....	.....	$664,848	8.274

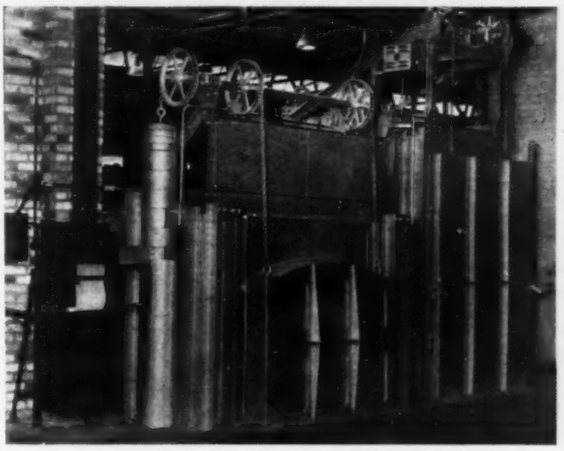
*Loss.

Large Carburizing Furnace Secures Recuperative Economies

By W. J. Diederichs
Industrial Heating Engineer
Westinghouse Electric & Manufacturing Company

A LARGE, single-end, box type furnace and a recuperating chamber, both of special design, have been combined as a unit for the carburizing and normalizing of machine tool parts with notable operating economies.

The furnace has an electrical input of 81 kw. for operation on 220-volt, three-phase power supply. By means of a switch the input can be reduced to 27 kw. for use during holding periods. Heating elements are located on the side walls, in the arch and on the floor between the channels, thus insuring uniform heat application during long heating periods. Alloy guards are provided for the side elements in order to protect them from any possibility of injury, even though work were to roll off a tray. The floor elements are protected by alloy floor plates. The recuperating chamber is designed to permit the trays of work to be carried at two levels, one above the other. The door of the recuperating chamber, as indicated in the illustration, is built in two sections and provided with a latching mechanism to make it possible to move the top half alone or the united parts as a single door.



Furnace-recuperative-chamber unit offers operating savings

In operating the furnace a loaded tray with cold charge is placed on the upper deck of the recuperating chamber. A heated charge is removed from the furnace at 1,650 deg. F. and immediately charged onto the lower deck of the recuperating chamber. Transfer of heat takes place to such an extent that while a charge in the furnace is being heated the cold charge in the recuperating chamber has been preheated to 600 deg. F. or more. The cooling charge is then removed from the bottom deck, to be replaced as rapidly as possible by a fresh hot charge from the furnace; the preheated charge from the upper deck is charged into the furnace and a fresh cold charge is placed on the upper deck. The manipulation of these trays as indicated above is rapid and efficient due to the use of the special crane.

The equipment is designed to handle 3,000 lb. of gross carburizing charge, or 3,000 lb. of net material to be normalized, per tray. The heating cycles vary consider-

ably, depending upon the nature of the work in hand. Based upon average procedure, the following results are typical of those attained:

The power consumption for carrying out a twelve-hour carburizing cycle on a 3,000-lb. charge at 1,650 deg. F. is 400 kw.-hours, which is equivalent to a gross economy of 7.5 lb. per kilowatt-hour.

The power consumption for carrying out a normalizing heat on a 3,000 lb. charge at 1,650 deg. F., requiring approximately nine hours in the furnace, is 340 kw.-hours which is equivalent to a net economy of 8.8 lb. per kilowatt-hour.

Simplification of Carbon Brushes

Multiplicity of grades, sizes and styles of brushes puts unnecessary burden upon manufacturer and user. Simplification offers possible saving of 50 per cent

By E. A. Williford
Manager Carbon Sales Division National Carbon Company, Cleveland, Ohio

SINCE the introduction of carbon material as a current-collecting device on commutators and slip rings the determination of the size of these carbon brushes has been left entirely to the discretion of the designing engineer. So far as can be ascertained no class in electrical machine design at any of our technical colleges lays any stress upon the selection of the carbon brushes other than on the basis of friction and carrying capacity. The size of the brush is usually determined by its supposed carrying capacity, the length being chosen either on the basis of a space factor or to be as long as possible consistent with general appearance. As a result, this has led to literally thousands of sizes and styles of carbon brushes, for which there is no engineering justification. To make this situation more complex, there are probably 500 grades of brushes available on the American market from which the designing engineer may make his selection, thus multiplying the possible combinations of brush grade, brush size and brush style almost without limit.

Brushes Made From Buyer's Specifications

As a result all carbon brushes have to be manufactured to the purchaser's specification on a special order at the time the customer orders his material. There is no such thing as shipment from stock in case of carbon brushes except in a few minor instances. This leads to small-quantity production, on which there are required from six to thirteen machine set-ups on orders ranging anywhere from two brushes up. It is impossible for the brush manufacturer to make up brushes in small quantities except at exorbitant costs, and this has led to the very bad practice of selling a small quantity of brushes below manufacturing costs rather than asking the customer to pay what look like an unwarranted charge.

Moreover, the customer in need of immediate delivery of brushes must wait until this very necessary accessory can be manufactured especially for him and, in many cases, the complete specifications are lacking, leaving entirely too much to the guesswork of the brush manufacturer. If for any reason brushes made up do not fit the brush-holder or the machine for which they are purchased they are a total loss, as they cannot be reprocessed and supplied on some subsequent order. Under these conditions it can readily be seen that industry is bearing a rather heavy burden of wastefulness owing to the multiplicity of sizes and styles of carbon brushes and brush shunts.

The real limiting factor in the selection of a commutator brush is commutation. The only dimension of the brush that has any effect on commutation is the thickness. Even here some latitude is possible, since commutation depends largely upon the number of coils short-circuited at one time, and hence the thickness of a brush may vary by almost as much as the width of the commutator segment without changing the number of short-circuited coils. The width of the brush is determined by the carrying capacity of that particular grade and the demand governed by the output of the machine. This carrying capacity of carbon brushes is a decidedly indefinite quality and is usually based upon safe operating temperatures secured in operation of a well-designed machine. The heating due to commutated current in the coils and that due to friction of the brushes sliding on the commutator are far more important in limiting the carrying capacity of the brush than the heating due to the load current itself. Considerable latitude, therefore, may be given on this matter of carrying capacity. For instance, four brushes $1\frac{1}{4}$ in. wide may carry the same current which may have been carried in the past by five brushes $1\frac{1}{8}$ in. wide. The selection of the length of the brush concerns the length of wear almost exclusively and, in the interests of simplification, broad concessions should be made in this dimension.

Many Styles of Shunt Attachments

There are many styles of shunt attachment, almost any one of which is satisfactory for the use to which it is put. Where a brush-lifting device is required, such as for rotary converters starting from the alternating-current side, this matter could be simplified by an exchange of patents, as it is doubtful if there is any real engineering advantage in one form over that of another. They all do the work for which they are designed, and it would seem that the commercial advantage of fewer types of such mechanism should far outweigh any engineer's ideas as to the advantage of his novel idea. The length of shunt and style of terminal could be particularly well

Ban on Power Export Costly to Public

"THE inability to sell, at any price, such surplus power as we may have from time to time is a very great drawback to our industrial development. Whenever a power plant is built it must be built larger than is immediately needed, and under the present conditions the service is obliged to go absolutely to waste until local customers absorb it. This means that the people of Maine pay more for their power in the average year than they would do if this waste power could be sold, no matter at what price it is sold."

From a statement to stockholders by Walter S. Wyman, *President Central Maine Power Company.*

standardized in two or three lengths and perhaps seven or eight styles of terminals for practically all applications larger than fractional-horsepower motors.

The advantages to be gained through simplification would accrue largely to the brush consumer; he would have a much smaller inventory to carry as spare parts in his store room; the interest charges on this investment would be reduced; he could secure quicker delivery of materials which he needs; he would be able to order the few styles he requires in larger quantities and save perhaps as much as 50 per cent in the unit cost of such brushes; brushes could be catalogued so that one particular size and style of brush would bear this standard catalog number, specifications of which would be known to all brush manufacturers and motor generator manufacturers, leaving only the necessity of specifying the grade that the consumer feels to be best adapted to his application. There are very few distributors in the brush business today due to the fact that it is not an economical proposition to stock brushes of so many varying types and qualities. If these styles were reduced to a smaller number brushes could be carried in stock by electrical jobbers for distribution to the small consumer and to isolated industries, such as coal mines.

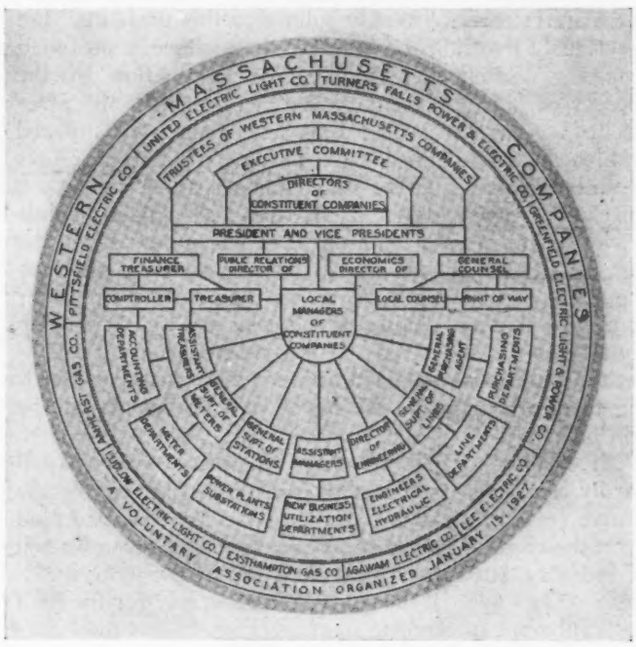
The motor and generator manufacturers would have fewer styles of brush-holders, thereby reducing their own inventory charges and simplifying the stock problem. They would have greater interchangeability of brushes for different types of machines and would not need to place orders for brushes so far in advance, as they now must do in order to secure prompt deliveries. These savings in the cost of machines would undoubtedly be passed on to the ultimate consumer, but with some compensation to the manufacturers themselves.

The brush manufacturer would benefit chiefly to the extent of eliminating the risk and waste to which he is now subjected in making up every order after the receipt of the customer's order itself. He would be able to mold individually the most important sizes of brushes, resulting in a more uniform product at a lower cost, which, in turn, would be passed on to the motor and generator manufacturers and to the brush consumers. Brushes could be placed in stock and shipped promptly upon receipt of customers' orders. Where brushes have been ordered through error on the part of some customer, they could be placed back in stock by the brush manufacturer instead of being scrapped, as now is done. Mass production would replace the present small order type of production and enable the American manufacturer to compete with the foreign manufacturer in foreign markets.

Realizing Flexibility in a Holding Company "Set-Up"

EARLY in 1927 a number of closely affiliated gas and electric utilities serving the Connecticut Valley and other parts of western Massachusetts organized a voluntary association designated as the Western Massachusetts Companies. These now include the Turners Falls Power & Electric Company, United Electric Light Company (Springfield), Greenfield Electric Light & Power Company, Pittsfield Electric Company, Amherst Gas Company, Ludlow Electric Light Company, Easthampton Gas Company, Agawam Electric Company and Lee Electric Company. The operation of these properties, with combined assets over $36,000,000 has been centralized and co-ordinated along the lines illustrated in the accompanying chart, the general policy being to maintain the individuality of local administration hitherto enjoyed by these constituents, along with their pooled financial, equipment, operating, executive and other resources.

The chart is practically self-explanatory. The trustees administer the association on behalf of the stockholders of the constituent companies, the immediate conduct of affairs being in the hands of an executive committee working in harmony with the directors of the local properties and through the president and vice-presidents of the holding organization. The administration of each constituent property centers in its local or resident manager, through whom contact is made with the headquarters staff officers and executives of the association. General jurisdiction over local company departments is exercised by specialist executives available to local managers on the one hand and over local departments on the other. The treasurers and comptrollers contact through the local managers with the subsidiary properties and also by direct line with the accounting departments of the constituent companies. The director of economics and engineering exercises the functions of a technical consultant for the association and its properties besides having executive charge of all electrical and hydraulic engineering activities with specialist executives reporting to him. These examples and examination of the chart will show that an unusually flexible and compact organization has been set up to allow the utmost freedom of co-operation between the officers and specialists of the association and of the constituent utility companies.



Maximum flexibility in administration and advisory functions is attained by this set-up

The chart is functional in its arrangement, and in some cases the same individual fills an office in a constituent company that he occupies in the association. Thus, the director of engineering indicated on the chart for each local company holds this post in the association general staff. The size and make-up of the local staff depend on the conditions in each local company.

Letters from Our Readers

Price Cutting the Seller's Fault

To the Editor of ELECTRICAL WORLD:

Apropos of Earl Whitehorne's article in the Feb. 18 issue of ELECTRICAL WORLD, entitled "Who Pays the Cost of Price Cutting?" the following is the reaction of a comparative newcomer in the ranks of the purchasing agents:

I hold no brief for those purchasing agents who are "beating down price levels by ingenious methods of induced competition." Such tactics will continue so long as the manufacturers "weakly submit to this pressure," but I seriously question the efficacy of the remedy proposed by Mr. Whitehorne, namely, the elimination of the secrecy of bids. My experience has been that the practice of requesting sealed bids has done more toward eliminating the unethical tactics of manufacturers' representatives than any other single consideration, for only a purchasing agent knows of the hundred and one subtle devices that are used in an effort to worm out of him the low bid price. Where sealed bids are used the purchasing agent has no other alternative than to give the order to the low bidder, quality of material and delivery being equal. To throw the bids open to examination by a competitor is to invite collusion between manufacturers, leading to efforts to make the buyer pay all that the traffic will bear.

Mr. Whitehorne's Utopian one-price system will hardly commend itself to any fair-minded buyer, for the simple reason that such a system is seldom if ever based upon the costs of the most efficient unit in a given branch of industry, but rather upon the costs of the more inefficient. The buyer is, therefore, forced to pay for the high costs inherent in obsolete machinery, worn-out manufacturing methods, slipshod cost accounting, topheavy overhead and inefficient distribution.

What, then, is the remedy for the admitted evils of price cutting? Quite frankly, I feel that the initiative should be taken by the manufacturers themselves, in desisting from their unethical practices of stealing business from their more efficient competitors by a ruthless cutting of prices. The inefficient manufacturer who cannot compete with his more efficient competitor has only one alternative to falling by the wayside, and that is to lower his costs. There is plenty of room for this in 90 per cent of electrical manufacturing plants.

Furthermore, the manufacturers should employ a few good salesmen rather than a flock of mediocre order takers. The right kind of selling organization would be able to evaluate such intangibles as better quality, prompt service, longer life, etc., in terms of dollars and cents, which is, after all, the deciding factor in a hard-headed, clear-thinking executive's mind. The purchasing agent would then buy not on the basis of price alone, but with due consideration for the other factors above mentioned.

I have no objection to showing a bidder the other prices when he is asked to reduce his price, provided that the identity of the bidder is not revealed, for to reveal the identity of the bidder is a breach of confidence of which the manufacturers themselves would be the last ones to approve. It seems to me that the personality of the purchasing agent is the governing factor, for I have yet to recall an instance where my word was questioned when I have offered an order to a bidder at a lower price.

My company pursues a liberal policy in its dealings with manufacturers, and has this year voluntarily granted an increase in prices for high-tension, paper-insulated cables in order that the manufacturers may be assured of a reasonable profit on their product and be able to set aside funds for research, but we do not propose to be coerced into paying higher prices than conditions warrant. DAVID WILLIAMS.

1121 Teller Ave.,
New York City.

Maintenance of Transformers and Circuit Breakers at Industrial Plants

To the Editor of ELECTRICAL WORLD:

In an editorial in the Feb. 18, 1928, issue of the ELECTRICAL WORLD you asked the question "Who should take care of the maintenance of transformers and circuit breakers at the plants of industrial customers?" In hundreds of small industrial plants that are electrically operated this problem more often than not remains unsolved, but comparatively little trouble is caused, on the whole, mainly owing to the remarkable reliability of the type of electrical equipment usually installed in such plants. In several cases where I have installed such equipment I have made an effort to get the power company to adopt some schedule for maintenance of the apparatus, arranging for the customer to pay the cost. In cases where the plant is large enough to maintain its own electrical staff this of course has not been necessary. The power company has frequently agreed, has never accepted the responsibility, but has awaited the call of the customer, who knows little or nothing as to the amount of maintenance necessary. In fairness it must be said that some power companies, although they are far too much in the minority, adopt a really constructive attitude and maintain the equipment not only in theory but in practice.

For the last few years circuit breakers with higher interrupting capacities have been installed and the trend in protection equipment has been toward overcurrent relays with battery-operated, direct-current trip coils. Such equipment can maintain its operating superiority only through proper maintenance. The writer's interest lies mainly in the fact that equipment which has been specified and installed may appear to the owner to be unsatisfactory even though its failure was due to improper maintenance.

You say in your editorial that it is a duty of the electric light and power company to maintain such apparatus and you further add that it takes but little persuasion to convince the customer that the power company should do the job. In this you are absolutely right, and when it can also be said that such maintenance work can be performed at no cost to the power company, but actually can be made to yield a fair and legitimate profit, the industry is missing an opportunity to capitalize on service reliability through proper maintenance of apparatus. May I not suggest that power companies following some such plan write of their experiences for the benefit of and as a guide to other companies to make such a practice more widespread. ENGINEER.

New York, N. Y.

[The author has submitted sufficient reasons for withholding his identity to justify our complying with his request.—EDITOR.]

Digest of Electrical Literature

Hydro-Electric Development and Steam Equipment

Tests of a 12,000-kw. Zoelly Steam Turbine.—Investigation of the operating characteristics of a Zoelly steam turbine operating under a pressure of 285 lb. per square inch and a temperature of 662 deg. F. at 3,000 r.p.m. was undertaken recently. The machine comprises ten simple impulse wheels with diameters ranging from 51 to 69 in. Results indicate a minimum steam consumption of 9.6 lb. per kilowatt-hour.—*Engineer (England)*, Feb. 17, 1928.

Transmission, Substations and Distribution

The Transmission of Alternating Current.—W. B. Woodhouse.—The adoption of the four-phase system for alternating-current transmission as a means of reducing the number of wires necessary for balanced protection, with other incidental but important advantages, is offered by the author. Comparative figures for two overhead lines bearing equal loads with equal efficiencies, one of four-phase construction and the other a three-phase, six-wire line, offer some interesting information regarding the mechanical properties of the conductors necessary to carry the load. A reduction of 18.5 per cent in the total mechanical loading of the line is indicated with four-phase design and it is stated that this will result in a proportionately greater reduction of the cost of the support and that the transmission line as a whole will be substantially cheapened on both accounts. The author concludes that the facility with which a three-phase system can be transformed into a four-phase system is such that four-phase high-pressure transmission may be combined with a three-phase generation and three-phase distribution without difficulty or undue complication, and the system of transmission may therefore be considered separately.—*Electrical Review (England)*, Feb. 17, 1928.

Calculating Sag of Wires for Unequally High Suspension Points.—G. Schmidt.—The methods generally used for the calculation of mechanical tension and sag in wires when stretched out between equally high supports are only approximately correct. Mathematical proof is given for this statement, and the problem is further developed to be applicable to unequally high supporting points, resorting to catenary or chain-line equations. The influence of exact calculation does not become apparent until actual examples are computed. It is of great value for the safety of the line to determine the exact but unequal stresses in the lower and upper support, to have full assurance that they stay within safe limits. Many methods and tabulations, which have been published lately, including supposedly authoritative ones for the calculation of wire sags, are stated to require corrections to give exact values.—*Elektrotechnische Zeitchrift*, Feb. 9, 1928.

Cable Conductor Losses.—C. G. Watson.—The author has devised a method for readily estimating conductor losses taking into account the maximum demand charge as well as the unit charge. On this basis one part of the total value of the loss will be the loss of the system peak multiplied by the cost per kilowatt of maximum demand, but as the maximum load of a cable does not always coincide with the system peak and as it is convenient to use the maximum current as a basis for calculation a correction factor is needed. This factor is said to be the square of the ratio between the current in the cable at the time of the system peak and the maximum current. Illustrative examples tend to prove the contention of the author in connection with the ideas developed in the formulas and charts.—*Electrical Review (England)*, Feb. 24, 1928.

Graphic Calculation of Reactors.—O. Gramisch.—The design of air-core, current-limiting reactance coils can be largely reduced to a simple graphical method by means of alignment charts given in this article. Such charts have been constructed for the size of the (copper) conductor, for the heating under short circuit, for the dimensions of the coil, and for the inductance. The practical solution of the problem of a given reactor for certain inductance, current and time values is not definite. Several designs must be laid out to find the most economical type. This procedure is illustrated by the actual design of a reactor for a 1,000-kva. transformer, using alternately formulas and alignment charts.—*Elektrotechnik und Maschinenbau*, Jan. 29, 1928.

Units, Measurements and Instruments

Construction of Great Falls-Winnipeg 110-Kv. Transmission Line.—J. C. D. Taylor.—The problems involved in the distribution of material for the construction of this 70-mile transmission line through two distinct types of country are considered by the author in the first of a series of articles. The details of the organization for the distribution of men and material has received particular attention. An unusual feature of the work was involved in the construction of a 12-mile narrow gage track for the transportation of materials and consisting of 6-in. trees bolted to road ties for use in connection with grooved wheel cars. The motive power was furnished by horses. The character of the ground was such that this was the most economical and desirable way of accomplishing the transport of line materials.—*Electrical News (Canada)*, March 1, 1928.

Motors and Control

Phenomena Under a Carbon Commutator Brush.—H. Lutz.—It is a known fact that the ohmic resistance between a carbon brush and commutator is larger when the machine is running than when it is standing still. Unavoidable irregularities on the surface of the commutator and the carbon particles continually ground off cause the brushes to be more or less in motion at all times. The size of these fine particles of carbon varies between 10^{-3} to 10^{-5} mm. or about 100 to 1,000 times the size of a carbon atom. Ionization and free electrons will occur under the brush. Contact between brush and commutator will only be point-contact, so that voltage drop will only depend upon the current and not the current density. Several small brushes or one wide brush with undercuts will give a better performance, according to the author, since there are more contact points. Reference is made in the paper to many previously published statements, which apparently agree with the author's recent experimental findings.—*Elektrotechnik und Maschinenbau*, Jan. 29, 1928.

Developments in Electric Pumping.—Blake R. Vanleer.—A general review of the subject of pumping has been made in connection with a discussion of the recently developed deep well turbine pump. The author has reviewed the advantages and service requirements which have led to the use of this type of equipment and has emphasized design and test features. A deep well turbine pump, while relatively inefficient, offers unusual features in that the motors may be mounted at the ground level, while the runners are attached to the shaft operating within the well at such intervals as may be desirable.—*Electrical West*, March 1, 1928.

Fifteen-Ton Electro-Hydraulic Ingot Casting Crane.—This crane comprises a motor-driven traveling carriage from the center of which rises a vertical pivot which acts as a fixed ram of a hydraulic center. This cylinder, which surrounds the ram, carries the main portion of the crane. The body of the crane has thus both a vertical and circular motion around the central pivot. It consists structurally of two main girders secured to the hydraulic cylinder surrounding the pivot by four sloping ties of steel plate. The operation

of this equipment involves the control of six motors, namely, two motors for traveling, one for each of the duties of raising the crane, turning it, reversing the ladle and tipping it. The two traveling motors are controlled by an automatic contactor, which assures a steadily progressive start without reference to the manipulation of the starting handle. The latter, having to deal only with very small currents, is easily moved. The lifting controller is operated by a lever and the connections are so made that the load follows the movement of the hand of the operator. —*Engineer (England)*, March 2, 1928.

Electrophysics, Electrochemistry and Batteries

Very High Direct-Current Voltages. —ERWIN MARX.—For general testing purposes, the production of cathode and X-rays, dust precipitation, cable tests and many other research investigations very high sustained direct-current voltages are required. The author shows how, with relatively low potential transformers, a many times higher direct-current voltage can be easily obtained, with the aid of suitable vacuum rectifying tubes and high-voltage condenser batteries. A small 100-kv. transformer can thus readily produce 600 kv. direct-current to ground. In fact, the potential multiplication can be carried readily to a factor of 10, making it possible to obtain 1,000,000 volts direct-current from a 100-kv. testing transformer.—*Elektrotechnische Zeitschrift*, Feb. 9, 1928.

Some Principles Governing the Choice and Utilization of Permanent-Magnet Steels.—RAYMOND L. SANFORD. The addition of substantial percentages of cobalt to the composition of permanent-magnet steels leads to markedly superior qualities. The cost of cobalt steels may be several times that of the older types, however, and their use is warranted only under certain circumstances. Criteria for the comparison of the quality of magnet steels are discussed, and the conditions under which the use of the more expensive steels are justified are outlined. Cobalt steels are superior in quality to tungsten and chromium steels, but this superiority can only be utilized by means of appropriate designs. The mere substitution to cobalt steel without change in design will usually lead to disappointing results. Magnets can be stabilized against permanent deterioriation from transient demagnetizing fields by partial demagnetization. The cobalt steels can be stabilized by this method to a greater degree than the steels having lower values of coercive force.—No. 567, *Scientific Papers of the Bureau of Standards.*

High-Voltage Reactors.—L. KROPFF. —In the discussion of general requirements of current-limiting reactors, some simple formulas are given to calculate size and number of turns required for any given condition. It is shown that the customary design, which is fully satisfactory for up to 6,000 volts, cannot be used economically for much higher voltages, since the mere lengthening of the creepage distances would lead to impossible dimensions. For use in feeder circuits of 30 kv. or more a new design for reactors has proved very satisfactory. Double section disk coils, porcelain spacers and the decidedly novel use of porcelain tension bolts with ball socket ferrules are the outstanding features of this new design. To eliminate static charges on the metallic clamping pieces, they are connected electrically to the ends of the winding. The conductor is made of ribbon copper, insulated with mica, which insures against dust troubles or winding "shorts" due to foreign metal parts. Reactors of this design will safely withstand a testing voltage of four times rated voltage.—*Siemens Zeitschrift*, January, 1928.

Telegraphy, Telephony, Radio and Signals

Fatigue Studies of Telephone Cable Sheath Alloys—JOHN R. TOWNSEND.—A discussion of mechanical and metallographical characteristics of fatigue failure of telephone cable sheath and the development of machines to duplicate service conditions. The correlation between the characteristics of service failures and laboratory failures is stressed. The special precautions necessary to carry out fatigue tests on soft metals is outlined. Fatigue failure of lead and the lead antimony alloys covered by this paper is by intergranular failure, and in the case of the lead antimony alloys repeated stress appears to reduce the solid solubility of antimony in lead, producing a widened grain boundary as viewed under the microscope. The type of fatigue test described is sensitive to very slight changes in composition and heat treatment for a particular class of material.—*Reprint B-285 Bell Telephone Laboratories.*

Generator for Audio Currents of Adjustable Frequency with Piezo-Electric Stabilization.—AUGUST HUND.—A beat-frequency generator for producing audio currents which are practically sinusoidal is described by the author. The frequency is adjustable and stabilized by means of a piezo-electric quartz disk and can be directly read off on a scale. The piezo-electric control makes it possible to reset the calibration for the frequency, for almost any B voltage on the tubes producing the two high-frequency currents which beat with each other. The resetting can be carried on without any standard by means of the filament rheostat common to both oscillator tubes. The slow visible vibrations on the meter for the anode current of the piezo-electric oscillator are utilized for the resetting of the scale. A thermostatic control is provided for very accurate work. Two filter detector circuits are described for obtaining audio currents of a good wave shape and keeping any high-frequency currents away from the load branch. A specially designed power amplifier is also mentioned.—*No. 569, Scientific Papers of the Bureau of Standards.*

Traction

New Railway Car Lighting System. —L. DREYFUS.—All hitherto known systems for electric lighting of railway cars provided with axle-driven generator and storage battery require a complex regulating apparatus to keep the lamp voltage constant at widely varying train speeds. The author has developed a new system, in which the generator is of such design that it makes any external or additional voltage regulator unnecessary. This has been accomplished by a machine with a double field and three pairs of small, fixed brushes on the commutator. An 18-volt, 9 amp.-hour auxiliary battery (fourteen alkaline cells) maintains the excitation field essential for the operation of this generator. The arrangement of the two counteracting fields and their connection to the six brushes is such as to maintain a practically constant potential of 24 volts on the lamp circuit and a 30 per cent higher voltage for the charging of the main alkaline car battery. The control panel contains only an automatic double-throw switch for "standstill" and "travel," a combined voltage and over-voltage relay, both of exceedingly simple and robust design, and four adjusting resistors. The generator is positively driven by bevel gears.—*Elektrotechnik und Maschinenbau*, Feb. 5, 1928.

Miscellaneous

Waste Heat Recovery.—A discussion of steam generation by waste heat. No reference is made to regenerative processes, air heating or similar expedients, the discussion being limited to certain definite aspects of steam generation by waste heat. The author states that despite economic factors there still appears to be some hesitation in the general adoption of waste heat boiler plants and that the reasons may be summarized as follows: Incomplete knowledge of the exact scope of waste heat recovery, particularly of its influence on fuel consumption and its general effect on the primary process; a tendency to lay too much stress on the troubles met with in pioneer plants installed before the principles governing the subject were properly understood; the practice in certain quarters of overstressing the possibilities of the generation; engineers responsible for the design and operation of furnaces, retort settings, internal combustion engines, etc., have confused waste heat with wasted heat, the latter being a potential reflection on their products. Considerations are largely devoted to steel plants, carbonizing processes and marine engines.—*Engineering (England)*, Feb. 24, 1928.

News of the Industry

Tennessee Tax Illegal

Commission's Imposition of One Mill per Kilowatt-Hour on Power Generated in Hydro Plants Upset by State Court, Along with Recapture Clause

HOLDING that although the Tennessee Eastern Electric Company must apply to the Railroad and Public Utilities Commission of that state for a certificate of convenience and necessity before proceeding with hydro-electric developments on the Holston River, none the less the commission's attempt to impose a tax or rental of one mill per kilowatt-hour of generated electricity on the output of hydro-electric companies is unconstitutional, the Chancery Court at Nashville handed down last week an opinion of far-reaching importance to the power industry of Tennessee and other states.

The court held that the Legislature has not conferred the taxing power upon the utilities commission; that the commission is not legally empowered to require the applicant for a certificate of convenience and necessity to agree to surrender its property at the end of 50 years under terms to be set out in such certificate; that the water-power value of the company's property must be included in the rate base, not on the basis of the cost at the time of acquisition, but on the basis of the present or existing value at the time the rate is to be fixed, and that the commission cannot exercise jurisdiction over the assignment, transference or alienation of the certificates of convenience and necessity to the exclusion of court authority.

Though in other matters the commission was upheld in its general jurisdiction over the power company and its right to issue certificates, require public hearings, fix rates, and generally oversee the development and distribution of power, the opinion is obviously a victory for the complainant power company, as the imposition of the one-mill tax or rental, the recapture clause and the jurisdiction claimed over assignments of the certificates were the sections of the commission's order from which the complainant was seeking relief.

Radio Bill Becomes a Law

After weeks of uncertainty and delay in Congress, President Coolidge on Wednesday signed the radio bill, passed by the Senate on March 24, after previous acceptance by the House, and it became law, effective at once. In addition to the provision extending for a year the life of the Federal Radio Commission as a control body and the clause providing for "equal" distribution of radio service to the five zones and "equitable" distribution among the states within the respective zones in accordance with population, the bill provides that broadcasting licenses shall be issued for not to exceed three months, instead of three years as at present, and other classes of licenses for not longer than one year, instead of five as under the existing law. Indications are that the new law will materially curtail the number of licenses and the power enjoyed by big radio centers like New York and Chicago. Unused wave lengths, time or station power can, however, be allocated elsewhere than to the zone originally entitled to them. The new license provisions are to terminate Jan. 1, 1930.

Elihu Thomson Attains His Seventy-fifth Birthday

THURSDAY of this week was the seventy-fifth birthday of Elihu Thomson, consulting engineer for the General Electric Company at its Lynn works. Dr. Thomson passed the anniversary quietly with his family at his home in Swampscott, Mass., but many letters and telegrams of congratulation reached him. Among the numerous honors that have been bestowed upon him in the course of his career have been the presidency of the American Institute of Electrical Engineers, the Grand Prix award, the Rumford, Edison, Elliott Cresson, John Fritz, Hughes, Kelvin and Franklin medals of American and foreign societies, and honorary membership in the National Electric Light Association. A special resolution in honor of Dr. Thomson was passed by the association's executive committee at a session on Thursday.

New Permits Granted by Federal Power Board

One for White River, Ark.—License for St. Croix Falls, Wis.—Applications for Sites on Roanoke, Flint and Salt Rivers

A PRELIMINARY permit for the White River Power Company of Little Rock, Ark., was authorized at a meeting of the Federal Power Commission held March 26. The company's plan provides for the construction near Cotter of a storage dam 226 ft. high. Other dams and power houses below Cotter, on the White River and on its Buffalo and North Forks, are planned. It is estimated that 70,000 hp. of primary power will be made available. It is planned to install 165,000 hp. A conflicting application by the Ozarks Hydro-Electric Company was withdrawn recently.

The application of the Western Washington Electric Light & Power Company for a preliminary permit on North River in Washington also was authorized. It is planned to install 40,000 hp.

A license was authorized for the St. Croix Falls Improvement Company covering a project on the St. Croix River in Wisconsin. It is proposed to install 66,500 hp. at Kettle River Rapids and at Nevere.

A license was granted to the Citizens' Light, Power & Water Company covering a constructed project on Ketchikan Creek in Alaska. The plant has an installation of 2,500 hp. A preliminary permit covering a proposed development on Ward Cove Creek, near Ketchikan, Alaska, was also authorized. The applicants are H. G. McCain and five others, all of Ketchikan.

The permit covering the project of Julian H. DeCoster of Idaho Falls and Steve Meikle of Victor, Idaho, on Palisade Creek was authorized. The applicants are required to determine the feasibility of storing water in the upper and lower Palisade lakes. It is planned to install 9,000 hp.

The Bunker Hill & Sullivan Mining & Concentrating Company was authorized to construct a 350-hp. project on Deadwood River, Idaho.

As no additional water rights are likely to be granted soon on Seepe and Piru Creeks by the California authorities, the commission rescinded its action in authorizing a preliminary permit for the Ventura Power Corporation.

The Roanoke River Power Company of Richmond, Va., has applied to the Federal Power Commission for a license covering a project on Roanoke River near Buggs Island. It is proposed to construct a dam 80 ft. high to create a

reservoir with 240,000 acre-feet capacity. The reservoir would extend upstream for 23 miles. It is planned to install 70,200 hp. and to construct a transmission line to connect with the system of the Appalachian Power Company. The primary capacity of the project is 8,900 hp.

J. J. Williams, O. M. Heard, W. E. Grubbs, P. F. Fitzgibbons and Dr. J. A Ward of Cordele, Ga., have applied for a license covering a project on Flint River. It is proposed to install four units of 3,600 hp. each. The license, if issued, is to be transferred to Crisp County. The power is for public use.

John L. Fish of Lakeside, Ariz., has applied for a license covering a project on Salt River, Gila County, Ariz. It is proposed to install 24,000 hp. capacity.

The Southern Sierras Power Company, of Riverside, Calif., has applied for a license covering a transmission line 13 miles long over public lands in San Bernardino County. The Western States Gas & Electric Company of San Francisco has applied for a license covering a transmission line from Camino to the tramway of the Michigan-California Lumber Company.

The City of Sand Point, Idaho, has applied for a preliminary permit covering a site on Priest River, in Bonner County, Idaho. It is proposed to construct four dams and power houses with an installed capacity of 10,000 hp.

House Committee Reports Its Shoals Bill

New Measure Differs Only Slightly from the Norris Bill Adopted by Senate, and Final Agreement Is Now Predicted—Leatherwood on Boulder Dam Bill

BY A VOTE of seventeen to four, the House military affairs committee on Wednesday, March 28, ordered a favorable report on a bill for government operation of Muscle Shoals which is so closely in agreement with the principle of the Norris resolution, already adopted by the Senate, that, if it is passed by the House, there is little doubt that differences between the two measures can be ironed out easily, thus assuring legislation at this session. The House committee bill, fathered by Representative Morin, the chairman, sets up a government corporation to be administered by a bipartisan commission of five members appointed by the President to operate Muscle Shoals, producing fertilizer and selling surplus power, instead of leaving operations to the Secretaries of War and Agriculture, as the Norris bill did. This is the principal difference. The government corporation to be set up will be capitalized at $10,000,000. Fertilizer manufactured is to be distributed equally among the states, territories and possessions.

Indications point clearly to passage of the committee bill by the House. The same influences which actuated the Senate majority in adopting the Norris resolution are being felt in the House—the promise of cheaper fertilizer for the farmers in an election year, the fact that no private offer for Muscle Shoals remains before Congress and utter weariness with the entire subject. These are sufficient, it is confidently believed, to overcome any opposition to government operation as a principle. Furthermore, it is believed President Coolidge will sign a government operation bill to dispose of Muscle Shoals if one is presented to him.

The bill reported out by the House committee Wednesday was to be formally reported to the House before the end of the week. With that accomplished, the chairman had been instructed to inform the rules committee that a rule to give the bill privileged status for action is sought. If this is granted, as is held certain, the bill probably will be voted upon in the House within the next four weeks.

Before voting upon the government operation bill, the House committee Wednesday took from the table for reconsideration the Madden bill embodying the bid of the American Cyanamid Company, which measure has been vigorously advocated by the American Farm Bureau Federation. A new recapture clause offered Monday in a letter to the committee was incorporated in the bill, but the measure, thus revised, was voted down by twelve to five, four members not voting. The Norris resolution was taken from the table and the committee bill was substituted for everything after the enacting clause.

It has not been decided whether the minority in the committee will submit a dissenting report to the House advocating substitution of the Madden bill. Representative Hill of Alabama, who voted against the committee bill, expressed his conviction that the appropriation of $10,000,000 in wholly insufficient, that the bill does not mean cheap fertilizer for the farmers, and that far from taking the matter out of the hands of Congress and assuring continuous operations at Muscle Shoals, it means that Congress must be consulted virtually every year and asked for additional money, which may or may not be given.

Leatherwood on Boulder Dam

An extensive minority report on the Boulder Dam bill has been submitted by Representative Leatherwood of Utah, who sums up his arguments as follows:

It proposes a serious invasion of state sovereignty in turning the Colorado River over to the federal bureaucracy. It accomplishes nothing immediately but the assurance of prolonged litigation between the states and the federal government. It is not a flood control project but a power project, wherein flood control is delayed indefinitely and subordinated to power development. It creates and invites international complications with the Republic of Mexico. Congress is asked to authorize at once the risking of the taxpayers' funds in an engineering experiment in the face of warnings that the project has had insufficient engineering studies and should be reviewed by the country's ablest engineers. It inaugurates a new socialistic principle in government expenditure—that the government may enter business whenever there is a promise that by so doing it may make a government undertaking 'self-supporting and financially solvent.' In this instance all known facts point to almost certain loss on the government's venture into business. Aside from flood control, the needs upon which the project is supposed to be based—more water for irrigation and domestic use in California, a market eager for power, improvement of navigation—are largely non-existent or can be just as well served by any other dam on the Colorado River. I find that not a single one of the major representations as to the project is true; that it has been promoted by political methods and not on its merits.

The bill authorizing the Federal Power Commission to employ its own personnel was rejected in the House by the close vote of 179 to 168. It is known that the Senate committee favors the bill and that it has a chance to pass the Senate. An effort probably will be made to attach the measure to some other legislation, with the possibility that it may be brought before the House again this session for another vote. The principal argument advanced against the measure was that it would make possible the building up of a new bureau.

New York-Paris Telephone Is Inaugurated

Transoceanic telephone communication between the United States and Europe was extended on Wednesday to France, conversation between New York and Paris being carried on with complete success. Sending and receiving circuits were connected with a loud speaker, and four hundred employees of the American Telephone & Telegraph Company in that company's assembly room heard the speeches made by President W. S. Gifford at the New York end and Maurice Bokanowski, French Minister of Commerce and Industry, at Paris.

Rate-Base Pleas Delay Work, Says Bay State Board

Declaring that the contentions of many companies on behalf of the reproduction-cost rate base retard its work, the Massachusetts Department of Public Utilities submitted a report to the Legislature on March 21 replying to inquiries of the House as to the rate-regulating situation in the state and set forth that ample authority exists to enable the commission to regulate rates within the time available. Between April 26, 1926, and March 15 last the board has held 445 public hearings, made 563 orders and findings and four special reports.

In answer to an inquiry as to the advisability of establishing a zone system of rates in the territory of the Boston Edison Company, the commission stated that evidence taken by it in recent cases puts

it in a position to bring about the establishment of such rates if it deems them just. The statute giving the board the right to initiate rate inquires has aided the commission's power of suggestion to companies whose rates appear to it to be open to reduction. The report points out that voluntary reductions have either been made by a number of leading companies or that cases are pending on the board's docket for their consideration.

Aftermath of the Disaster at Los Angeles

One of the Generators Left Standing on Site of Plant No. 2 May Be Salvaged — How the Edison Company's 220-Kv. Vincent Line Proved Its Worth

INVESTIGATION into the condition of the two 17,500-kw. General Electric turbines which were the only parts of Los Angeles' municipal plant No. 2 left after the waters let loose by the failure of the St. Francis Dam had receded indicates that one of them will probably be salvaged but that the other is in very bad shape and the possibility of repair is doubtful. No plans for rebuilding plant No. 2 have yet been announced, and it is said that should work begin immediately, it would require at least a year to complete it. Engineering testimony so far elicited points to the unstable character of the rock forming the foundation of St. Francis Dam as the cause of the disaster.

Information which was received just too late for last week's news recounts that after the flood had left the mouth of San Francisquito Canyon, headed for the ocean, it crossed the two 220-kv. Big Creek lines of the Edison company. Nine towers were torn down in the west line. This line was repaired and in operation by 5 p.m. March 16, three days after the flood. The East Big Creek line, immediately adjacent to the west line, had three towers destroyed. This line was put back into operation March 19. The third, or Vincent, 220-kv. line was not affected. To provide for just such emergencies as existed during and after this flood this third line had been built by the Edison company over a new right-of-way entirely separate from the original two lines. When the original two lines went out the hydro load was immediately transferred to the Vincent line.

The Saugus switching station of the Southern California Edison Company at the mouth of San Francisquito Canyon was put out of commission temporarily. Service to Santa Barbara and Ventura Counties was interrupted when this switching station went off the line. The Edison company had 300 men on the ground before daybreak Tuesday morning, March 13, and had built a temporary line around the Saugus switching station to serve these two counties before business opened up in these communities.

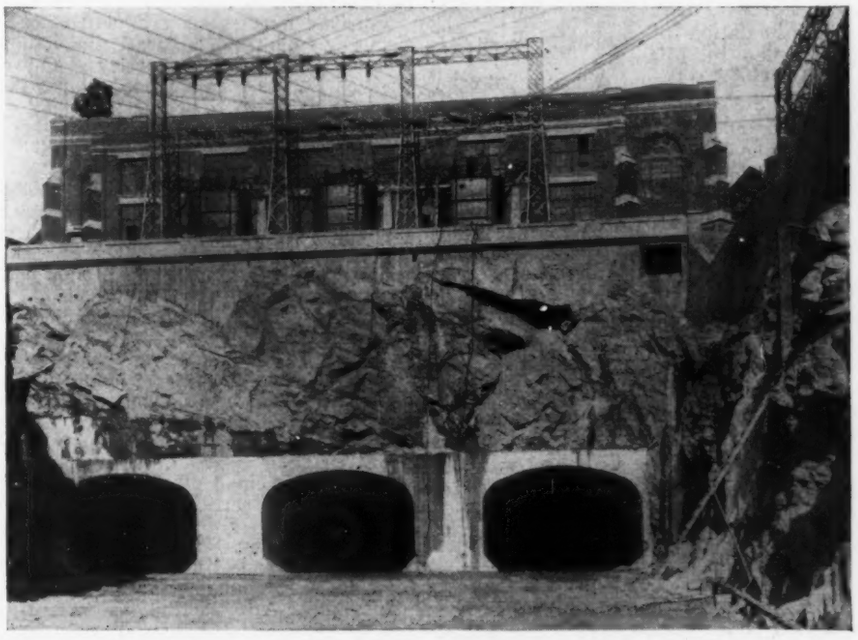
On a mesa immediately adjacent to the bed of the Santa Clara River, down which stream the floodwaters raged, the Edison company had a construction camp of 178 men. This camp was about 22 miles away from the St. Francis Dam. The floodwaters covered this tableland and destroyed the camp. Of the 178 men in the camp, 42 have been found dead and 42 were still missing when this account was prepared. Ninety-four escaped alive. C. W. English lost his life and B. D. Haugh suffered a broken leg and serious internal injuries when the airplane in which they were flying to reconnoiter the affected area crashed on a mountain peak in the vicinity of St. Francis Dam. These men were both connected with the operating department of the Edison company.

A resolution of the Board of Water and Power Commissioners of Los Angeles expressing its sympathy for the loss of life by employees of the Southern California Edison Company and expressing "appreciation and gratitude" to the company was made March 14. The Edison company's monetary loss will not exceed $100,000. That of city bureau property is now put at $5,000,000.

Floods in Sacramento Valley Do No Serious Harm

Heavy seasonal rains in central and northern California lasting from March 22 to 26 brought flood conditions to many Sacramento Valley points and caused the Pacific Gas & Electric Company and the Great Western Power Company some inconvenience. All storage reservoirs are spilling heavily, but no damage of any consequence to structures other than canals and flumes has been reported. One small power plant belonging to the Pacific Gas & Electric Company had three feet of water over the power-house floor, but little damage was done to the generator and other equipment. Some of the reclaimed areas in the Sacramento Valley are flooded, but service interruptions of the two power companies have been local and only minor in character. Ability of the companies to maintain power service to drainage pumps was the means of saving crops on many thousands of acres of reclaimed land in valley regions.

Bellows Falls (Vt.) Hydro Plant on Line



THE new, 60,000-hp. hydro-electric station of the New England Power Association on the Connecticut River at Bellows Falls, Vt., was phased into the system on March 27. The development includes a generating plant with three 20,000-hp. vertical single-runner Francis-type waterwheels, each directly connected to a 17,000-kva., three-phase, 60-cycle generator. The project required raising the old dam and providing additional spillway and canal facilities, as well as the construction of a new power house. The dam is of the gravity-section concrete type, 620 ft. long, with two bays equipped with roller gates, each with a height of 18 ft. The canal is 1,700 ft. long. The operating head is 60 ft.

Energy is generated at 6,600 volts and stepped up to 66 kv. and 110 kv. for transmission. Connections operated at 44,000 volts feed north into New Hampshire and Vermont, connecting with the system of the Vermont Hydro-Electric Corporation at Charlestown, N. H. The 66-kv. substation ties south in Vermont to Putney and Vernon. From the 110-kv. substation a 60-mile, double-circuit steel-tower line on private right-of-way delivers energy to an important switching station at Pratt's Junction, Mass., from which point 66-kv. lines radiate to load centers in New Hampshire, Massachusetts and Rhode Island.

Work was begun in May, 1926, the New England Power Construction Company acting as engineer and the Sherman Power Construction Company, Worcester, Mass., as contractor.

Purchases and Mergers

Atlantic Public Utilities Changes Hands —New Insull Company Organized— Dothan, Ala., Will Sell Plant for $2,000,000—Many Small Transactions

CHASE & GILBERT, Boston, have acquired the Atlantic Public Utilities from Charles W. Young & Sons of Boston and will manage these properties henceforth. Besides water companies, the group includes the Provincetown (Mass.) Light & Power Company, Indiana Light & Power Company, General Utilities Company, Ohio Northern Public Service Company, Shenandoah River Power Company, Brookville (Ind.) Electric Company and the Colby Light & Power Company of New Sweden, Me.

The Illinois Commerce Committee has before it the application of the Super-Power Company of Illinois to organize a fourteen-million-dollar electrical power corporation to function with Insull interests. The petition discloses plans to purchase the property of the Powerton Electric Generating Company, involving affiliation with the Commonwealth Edison, Illinois Power & Light, Public Service of Northern Illinois and Central Illinois Public Service companies.

Consolidation of nine public utility companies in Missouri, Kansas, Nebraska, Oklahoma and Alabama into the Central States Edison Company was announced on March 28. Electric light and power companies included are Gasconade Power Company, Hermann, Mo.; the North Kansas Power & Light Company, the Beatrice (Neb.) Power Company, the Gulf Utilities Company and the Foley (Ala.) Light & Power Company.

Dothan, Ala., whose municipal power system has had various vicissitudes, voted recently by 1,174 to 671 to authorize the City Council to sell the municipal electric and water properties for $2,000,000. No offers were pending. The Alabama Power Company was not a bidder at that price. In June of last year the city voted by 710 to 672 against selling the electric plant to the Gulf Electric Company, a subsidiary of the Alabama Power.

Barton, Vt., has agreed to purchase the one-man power plant owned and operated in that town for 20 years by Dr. E. M. Nichols for $117,000. The Public Utilities Corporation had offered a better price for the plant without success. Voters decided to operate it as a municipal property and will issue bonds to cover the purchase price. Dr. Nichols bought the property in 1908, when it had 30 customers, for $2,800. It now has 103 miles of transmission lines.

A certificate has been filed at Albany under which the New York State Electric Corporation merges the Georgetown Electric Lighting Company.

According to Fred L. Santway of Theresa, N. Y., president of the Hydro-Electric Power Company, approximately $75,000 will be spent there this summer in development work to combine the Hydro-Electric, the Snell and the Makepeace Power companies, which will then be sold to the St. Lawrence Utilities Company.

Alleged attempts by undetermined interests to obtain options on the property of twelve independent electric utilities on the Eastern Shore of Maryland, with the promise of lower rates through the transmission of energy from the Conowingo Dam, are being investigated by the Public Service Commission of Maryland. The communities concerned are Cecilton, Millington, Betterton, Chestertown, Church Hill, Centerville, Queenstown, Easton, Oxford, Trappe, St. Michaels and Claiborne.

The Southern Ohio Electric Company of Athens, Ohio, has petitioned the Public Utilities Commission for permission to buy the Hocking Power Company of Nelsonville for $530,826 and the Mutual Electric Company of Pomeroy for $65,455.

By a special election in Emmetsburg, Iowa, the Municipal Utilities Company of Des Moines has been authorized, by a vote of 941 to 366, to install and operate an electric plant to cost $147,000. The Des Moines concern, which is in effect a financing corporation, agrees to turn the plant over to the municipality when earnings have paid for the original cost and maintenance. The Iowa Public Service Company unsuccessfully sought a franchise in Emmetsburg.

The citizens at Ashby, Minn., cast an almost unanimous vote in favor of selling the Ashby lighting plant to the Otter Tail Power Company.

The Central Public Service Corporation has bought the electric distribution system of the Worcester Lumber Company at Chassell, Mich. This purchase is for the Houghton County Electric Light Company.

Purchase by the Dakota Public Service Company from the Northern Utilities Corporation of the electric property at Cleveland, N. D., has been approved, as has the purchase by M. A. Erickson of Rugby of electric properties at Souris and Westhope from Victor Frykman and the Condit & Son Electric Company respectively.

The village of Lushton has sold its distribution system to the Iowa-Nebraska Light & Power Company, from which it has been buying wholesale. The company will reduce lighting rates and offer a new service for range and refrigeration.

Approval of the Kansas Public Service Commission has been granted for the sale of the municipal electric light and power plant at Coldwater to the Western Light & Power Corporation, Salina. Sale of the Natoma (Kan.) municipal distribution system to the Kansas Power Company, Topeka, has been agreed upon by the City Council. The city will retain title to the power-house property. Negotiations have been completed for the sale to the Kansas Utilities Company, Fort Scott, of the municipal plant and distribution system of Toronto, Kan. Buildings are not included.

Citizens of Atwood, Kan., have voted to sell to the Central Kansas Power Company, with headquarters at Hays, the city's electric plant and distribution system.

The electric plants at West Union and Salem, West Va., have been sold by the Mountain State Utilities Corporation to the Monongahela-West Penn Public Service Company of Fairmont.

Rio Grande City, Falfurrias, La Pryor, Palacios, Waelder and Flatonia are listed by the Central Power & Light Company as the Texas towns where existing properties were acquired by it in 1927.

The electric light and other utilities at Caddo, Tex., have been sold to S. R. Morgan of Little Rock, Ark., for $75,000.

Option on the sale of the Kellogg (Idaho) Power & Water Company for $250,000 to an unnamed Eastern syndicate was announced by President J. S. Ramage at Spokane, Wash., recently. A distribution system at Kellogg, in the Idaho Panhandle mining district, and a small generating station are involved.

A holding company to be known as the Stevens County Public Service Corporation is being organized at Spokane, Wash., to hold the common stock of the Stevens County Power & Light Company, A. H. Sperry, president of both, announces.

Sale of the Capitola Company, supplying energy to Capitola, Calif., to the Public Utilities California Corporation, a W. B. Foshay company, has been sanctioned by the California Railroad Commission.

Application has been made to the California Railroad Commission by the Pacific Gas & Electric Company for permission to merge the properties of the El Dorado Power Company, the Western States Gas & Electric Company and the Coast Valleys Gas & Electric Company with its system and for the acquired utilities to abandon public utility service. Control of these companies was purchased from the Byllesby interests by Pacific Gas in May, 1927.

Fifteen Pennsylvania power companies, all owned by the Potomac Edison Company, with headquarters at Hagerstown, Md., have been consolidated. The new company, which includes the Waynesboro Electric Company and fourteen township companies in Franklin, Fulton, Adams and Bedford Counties, will be known as the South Pennsylvania Power Company and will continue to be controlled by the Potomac Edison.

Great Western Is to Purchase Feather River Company

The Great Western Power Company of California has applied to the Railroad Commission for authority to take over control of the Feather River Power Company, whose Bucks Creek plant on the Feather River is scheduled for completion by July 1. The application provides that a controlling stock interest in the Feather River Power Company is to be purchased by the Western Power Corporation of New York but shall be conveyed at the original purchase price to the Great Western Power Company of California on or before the expiration of two years.

The properties of the Feather River Power Company are valued at approximately $9,000,000 and consist of the Bucks Creek hydro-electric development with a 55,000-hp. plant which will utilize water from a 110,000-acre-ft. storage reservoir under a head of 2,561 ft. At the time the Bucks Creek development was started the Great Western Power Company contracted to purchase the entire output of the plant for a period of 35 years, at the expiration of which period the plant was to become the property of the Great Western.

Connecticut Light & Power Adds to Hartford Office

Effective tomorrow, April 1, the engineering, merchandise sales and advertising staffs of the Connecticut Light & Power Company, as differentiated from the company's operating organizations, will move from Waterbury to 36 Pearl Street, Hartford, which has for some time been the headquarters of the president, treasurer and general financial interests of this utility and the Connecticut Electric Service Company.

Rocky Mountain Men Sponsor Underground-Stream Survey

With a view to enhancing the value of agricultural resources and at the same time developing a substantial power load, the electric utility companies of Colorado, New Mexico and Wyoming will undertake a survey of the underground streams in their territory. This ambitious movement was launched at a joint conference of the Colorado Utilities Association and the Rocky Mountain Division of the National Electric Light Association held at Colorado Springs on March 19 and 20. While the public utilities are sponsoring the project and will largely direct it, the actual work of making the survey will be undertaken by the Colorado State Agricultural College under the supervision of President Charles A. Lory. The utility men of the Rocky Mountain States believe that this project will give a great impetus to rural-line extension and development and create heavy pumping load in at least a dozen localities.

Utility men from half a dozen Western states attended the meeting, and every phase of their industries received attention. Meetings were conducted by various chairmen, who used questionnaires, to which those in attendance responded with expressions of their views and experiences. Engineering commercial surveys, the value of national association committee research, local committee work, the tendency away from hydro-electric to steam-electric generating, overhead systems, inductive co-ordination, meters, underground systems, high-pressure turbines and the use of powdered-coal fuel were the engineering topics. V. L. Board, Public Service Company of Colorado, led the discussion of public relations, followed by H. S. Sands, who spoke on co-operation with educational institutions, and George H. Shaw. Meetings of the Commercial and Accounting Sections were also held, under G. B. Buck and Harry Adler, respective chairmen.

Minnesota Governor Opposes Backus Plans for Border

Governor Theodore Christianson of Minnesota has joined in the opposition to the construction of a series of dams on the Minnesota-Ontario border as proposed by E. W. Backus of the Backus-Brooks Company, Minneapolis. The Governor, in a letter to the secretary of the state Izaak Walton league, declares: "I do not favor the exploitation of publicly owned water and lands of this region for hydro-electric purposes by any private interests."

A state survey of Minnesota's power potentialities on the basis of which legislation fully protecting the public's rights should be drawn is advocated by State Auditor Ray P. Chase. With engineering facts as a basis, the state should then set about to determine what waters could be best utilized for industrial or power purposes and which should be retained in their primeval conditions for recreational purposes, he said, adding:

"It has been the history of Minnesota that in some instances applications for authority to construct dams have not been filed until after the dams were constructed and the power plants in operation. Of what avail is it to talk of public rights after those rights are gone? The Federal Power Commission requires that any applicant company comply with all of the state's laws before an application is granted. The commission declares that it does not claim and never has claimed authority to dispose of the use and ownership of public waters, but thus far it has been unable to find any statute of Minnesota requiring the consent of the state as a condition precedent to the construction of dams impounding the waters of the streams of this state."

Maryland Utility Men Meet in Baltimore

In addressing the members of the Maryland Utilities Association at the sixth annual convention, held in Baltimore, March 23, and referring to the federal investigation, Governor Albert C. Ritchie of Maryland stated that he perceived no indication that the utilities of the country were trying to take advantage of the public. Public ownership of the securities of these companies, and hence of the companies, was, he said, the greatest safeguard of the public interests. The relation between the utilities that want to serve and those whom they desire to serve was seen by the Governor as constantly improving.

The electric light and power, gas, water and transportation groups met separately in the morning session and jointly in the afternoon. Following the committee reports on meters and rural development, Earl Whitehorne, commercial editor of the ELECTRICAL WORLD, outlined the economic and promotional factors involved in the present inadequate development of the national domestic consumption of electrical energy. L. S. Storrs, managing director American Electric Railway Association; Major Alexander Forward, managing director American Gas Association, and Major H. S. Bennion, director of engineering, National Electric Light Association, referred to some of the problems confronting their respective industries. Major Bennion stressed the fallacies entertained by those uninformed on interconnection, with particular reference to the economic inadvisability of power transmission over great distances, and gave figures showing the limited amount of power involved in interstate transmission.

President H. B. Potter presided. The officers elected for the coming year are: President, H. T. Connolly, Washington, Baltimore & Annapolis Electric Railroad Company; vice-president, H. A. Brooks, Potomac Electric Power Company; treasurer, R. E. Towne, Potomac Edison Company; secretary, David Kinneau, United Railways & Electric Company.

Ontario Premier Tells of the Hydro's Problems

In a discussion on hydro-electric estimates in the Ontario Legislature recently Premier Ferguson forecast the complete utilization of Ontario's water-power resources within a few years. Even allowing for a possible increase of 500,000 hp. on the Ottawa River should the questions now before the Supreme Court be decided in favor of the province, a possible 1,000,000 hp. from the St. Lawrence development and a possible 500,000 hp. from additional diversions at Niagara Falls which might be arranged by international treaty, the Premier thought that, with the power consumption of the province increasing each year by 100,000 hp., it would not be long until all available power would be utilized. "There is delay over which we have no control in connection with the St. Lawrence development," said the Premier. "It is now four years since we filed at Ottawa our plans for power development." He had asked Premier King for the report made to the Ottawa government by the National Advisory Council, but, as the matter had an international aspect, Mr. King had declined to make the report public.

Experiments were being made, according to Mr. Ferguson, with what he called a "booster system." Should these work out successfully, the Hydro system might, the Premier thought, be able to transport power with comparatively small loss from sources in northern Ontario which are wholly within the control of the province. Otherwise it would have to depend on the boundary sources owned jointly with Quebec or with the United States.

A vote of $1,250,000 for transmission and distribution lines on the Ottawa system was passed, as was one of $350,000 for transformer stations. A great increase in the load being carried on the Georgian Bay system, particularly between Waubaushene and Midland, and 62 miles of rural extension on that system accounted for a vote of $75,000 for that district. Approximately one million dollars will be spent on the Niagara system this year.

Ontario Hydro Statistics Put Before Legislature

Provincial Treasurer J. D. Monteith told the Ontario Legislature the other day that the total horsepower in use by the Ontario Hydro-Electric Power Commission was now 1,600,000, with another million available. The Hydro paid into the treasury in 1927 for interest $7,848,043, Mr. Monteith said. The commission fulfilled its undertaking in regard to debt retirement, making a payment of $1,338,567, which represented its share of the $3,000,000 required on this account. "The finances of the Hydro are today in a very strong position," the Minister declared. "It has met all its obligations and even widened its usefulness by annual expansion."

The total available undeveloped power

in the province was estimated at 5,000,000 hp. The number of miles of transmission lines is 7,066. In 1927 807 miles of rural transmission lines were constructed, and the government contributed $1,100,000 in rural bonuses on this account. The entire debt of the province at the end of the fiscal year 1927 was $147,485,906, and the number of homes served by the Hydro-Electric Power Commission was 420,000.

Work for Utilities by Commission Men Criticised

Governor F. R. Zimmerman of Wisconsin has sent a letter to the Wisconsin Railroad Commission condemning the practice of permitting employees of that body to work for public utility companies. He even suggests that all commission employees be requested to sign contracts that they will not upon leaving the commission enter public utility employment for a period of one year. The Governor's letter was prompted by a report made to the Legislature by the Railroad Commission in which the latter listed a large number of employees who were doing outside work for the public utilities and also listed a number of commission employees who later were permanently employed by public utility companies.

Peek Tells of His Researches Into Lightning Phenomena

Tests with artificial lightning on small models in the Pittsfield, (Mass.) laboratory of the General Electric Company reveal that there is always a protected cone about a tall building or lightning rod, F. W. Peek, Jr., consulting engineer of the company in charge of high-voltage investigations, declared at New York on March 22 in a talk before members of the American Institute of Electrical Engineers. The radius of this protected area extends from the base of the building a distance of two to four times the height of the building, depending upon the altitude of the storm cloud. The chance of another building in this protected area being struck depends upon whether or not it extends above an imaginary line drawn from the top of the taller building to the edge of the protected area, Mr. Peek said. How these laboratory experiments were borne out in a natural electrical storm over New York last August when the New York World building was struck was described.

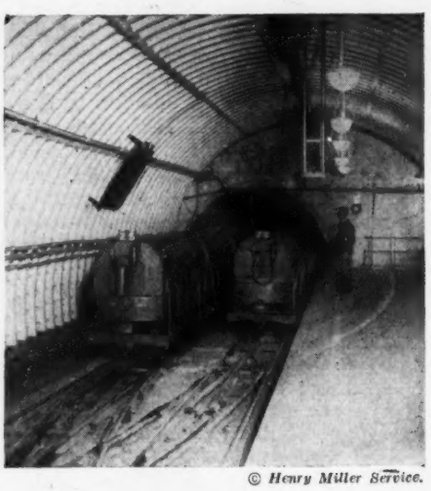
These laboratory experiments have progressed so successfully, according to Mr. Peek, that the protected-area plan has already been adopted in the safeguarding of oil-storage tanks in southern California. Several tall rods, placed near the outside of the big oil reservoirs, provide overlapping protected areas and thus greatly reduce the hazard of conflagrations from lightning flashes.

Another point touched on by Mr. Peek was that a cathode-ray oscillograph had been constructed in the laboratory by which lightning has been made to "write its autobiography" with a pencil of electrons on a photographic film. The lightning flash not only records itself but sets the device in operation, causing it to work automatically and at the correct time, although the flash may last but a few millionths of a second.

Briefer News

NEW HIGH-TENSION LINE UNDER WAY FOR WASHINGTON WATER POWER COMPANY.—A 110-kv., 40-mile transmission line is being built by the Washington Water Power Company from its Long Lake power station to the East Side substation at Spokane. The line is of two-pole construction and will give increased capacity from the power station to Spokane and the Cœur d'Alene mining district of northern Idaho.

LONDON HAS MINIATURE MAIL-TUBE RAILWAY.—In a tube railway recently built by the General Post Office of London, England, trains carrying mail run without a driver between Mount Pleasant, Whitechapel and Paddington at the rate of 35 miles an hour. The trains are operated by electricity from a control room in the Post Office. It is the first tube system of its kind.



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HIGHWAY AUTHORITIES AND TRANSMISSION LINES.—The right of highway authorities to supervise construction of power transmission lines on public roads is at issue in Iowa, where a permanent injunction has been obtained in Kossuth County to prevent the Central States Electric Company from erecting a line not in accordance with specifications made by the county engineer. Similar suits are pending in Pocahontas and Greene Counties.

CHATS FALLS (QUEBEC) HYDRO PLANT TO START WITH 30,000 HP.—Plans have been announced for the development of the Quebec side of Chats Falls, on the Ottawa River, one of the few remaining major power sites in the Ottawa district. Plans of the Chats Falls Power Company, as filed with the Quebec government, call for an initial development of 30,000 hp. in two 15,000-hp. units. The site has a potential development of about 90,000 hp. It is also probable that High Falls, on the Lievre River, also in the Ottawa district, will be developed in the near future. The power rights at this site are owned by the Maclaren Lumber Company of Buckingham, Quebec.

OKLAHOMA GAS & ELECTRIC COMPANY DEDICATES NEW OFFICE BUILDING.—On Saturday, March 24, the new office building of the Oklahoma Gas & Electric Company at Oklahoma City was thrown open to inspection by the public, who thronged its offices, salesrooms and auditorium. The building, at Main and Harvey Streets, is of steel and stone and rises six stories. It is so designed that an additional six stories can be added in accordance with the architect's plan illustrated in the ELECTRICAL WORLD for March 19, 1927 (page 623.)

ELECTRICITY BRINGS PROSPERITY TO NORTH CAROLINA MINES.—Completion by the Carolina Power & Light Company of a 47-mile, 60,000-volt transmission line from Asheville to Spruce Pine, N. C., at a cost put at more than half a million dollars, has, local reports say, brought a boom to the mining community reached, which had previously only about 75 kw. connected. In three months many mining industries have doubled their capacity and new industries have gone in.

AMERICAN COMMITTEE FOR TOKYO CONFERENCE ORGANIZED.—Engineering leaders from many parts of the United States met at Washington on March 22 and formulated preliminary plans for participation in the World Engineering Congress which will be held next year in Tokyo. Officers elected for the American committee were: Honorary chairman, Herbert Hoover; chairman, Elmer A. Sperry; vice-chairman and chairman of the executive committee, John W. Lieb; vice-chairmen, C. E. Grunsky and C. E. Kettering; executive secretary, Maurice Holland. The Japanese Ambassador, Tsuneo Matsudaria, and Dr. Sperry addressed the engineers at a dinner following the meeting.

MILLER RUBBER COMPANY AT AKRON NOW COMPLETELY ELECTRIFIED.—Installation of a new cooling plant for the Miller Rubber Company, Akron, Ohio, has been carried out by the Northern Ohio Power & Light Company. In addition, the company's engineers have supervised the entire electrification of the Miller factories, which cover 35 acres of ground. A substation of six 2,000-kw. transformers, with necessary switching equipment, has been erected and two 750-kw. synchronous motor-generator sets have been installed. An outdoor switching and transformer sub-

station receives 22,000-volt, three-phase, 60-cycle power from the utility company, which is stepped down to 2,200 volts. The Miller plant now consumes electrical energy at the estimated rate of approximately 32,190,000 kw.-hr. annually.

TRANSMISSION LINE WILL CROSS BIG MUDDY IN SINGLE SPAN.—The Central Illinois Public Service Company's 33,000-volt transmission line has been completed from the West Frankfort substation to Royalton, as far west as Freeman Junction, and from Royalton to the edge of Big Muddy River. The Big Muddy will be crossed at this point by a 1,015-ft. span. The 11,000-volt transmission line to Louisville has been completed, as has also the Teutopolis-Montrose 11,000-volt line.

NORTHWEST ACCOUNTING SECTION MEETS AT PORTLAND.—Committee reports, a thought-provoking discussion of published financial statements and the presentation by L. J. Pierce of a different conception of public relations and the accountant's responsibility therein than has prevailed were the principal features of the meeting of the Accounting Section, Northwest Electric Light and Power Association, at Portland, Ore., on March 12. F. W. Brownell, chairman of the section, outlined a broadened scope of activity.

MICHIGAN COMPANIES ESTABLISH FARM ELECTRIFICATION RESEARCH FELLOWSHIP.—Substantial recognition of the progress that Michigan State College is making in adapting electric power to the work of farms in the state has come in the form of an offer from the Detroit Edison Company and the Consumers Power Company of a fund for the establishment of a farm electrification research fellowship. With this offer came the tender of a second fund for the equipping and operating of a farm electrification demonstration truck to be sent out through the state this coming summer and fall under the direction of the Michigan State College. The fellowship fund is to be $2,000 a year for two years while the truck demonstration fund is $2,500. The fellowship will be awarded to a graduate engineer—preferably to an agricultural engineer.

ULTIMATE PRODUCTION OF 170,000 HP. ON ROANOKE RIVER PROPHESIED.—Ultimate development on the Roanoke River in Virginia of approximately 170,000 hp. is a prophecy based on the announcement that the Roanoke River Power Company of Richmond has applied to the Federal Power Commission for permission to construct a dam and power station on the Roanoke that will develop 70,200 hp., with transmission lines tied in with those of the Appalachian Power Company. The proposed power plant, at Buggs Island, is a few miles above the upper power site owned by the Virginia Electric & Power Company. The latter owns four power sites on the Roanoke, only one of which, at Roanoke Rapids, N. C., is developed. The three others are below the site of the Roanoke River Power Company's proposed plant, and it is thought that at least one of them may be developed by the Virginia Electric in the next two or three years. The Roanoke Rapids plant furnishes about 8,000 hp., and the three undeveloped sites are thought to be capable of producing 30,000 hp. each. Thus when all the Virginia Electric & Power Company's sites are developed that company will have available from the river nearly 100,000 hp., which, added to the Roanoke company's 70,000 hp., gives the top figure hoped for.

Coming Meetings

[A complete directory of electrical associations, with their secretaries, is published in the first issue of every volume. For latest list see ELECTRICAL WORLD for Jan. 7, page 80.]

Southwestern Division, N. E. L. A.—Edgewater Gulf Hotel, Biloxi, Miss., April 3-5. S. J. Ballinger, San Antonio Public Service Company, San Antonio, Tex.

Nebraska Section, N. E. L. A.—Omaha, April 4 and 5. T. A. Browne, 1527 Sharpe Bldg., Lincoln.

Southeastern Division, N. E. L. A.—Miami, Fla., April 11-14. C. M. Kilian, 207 Bona Allen Bldg., Atlanta.

American Institute of Electrical Engineers—Baltimore regional meeting, April 17-19; New Haven regional meeting, May 9-11; national convention, Cosmopolitan Hotel, Denver, June 25-29. F. L. Hutchinson, 33 West 39th St., New York.

American Welding Society—Engineering Societies Building, New York, April 25-27. M. M. Kelly, 29 West 39th St., New York.

American Electrochemical Society—Bridgeport, Conn., April 26-28. C. G. Fink, Columbia University, New York.

Missouri Association of Public Utilities—Jefferson City, April 26-28. F. D. Beardslee, 315 North Twelfth St., St. Louis.

Arizona Utilities Association—Prescott, Ariz., April 26-28.

Southwestern Public Service Association—Dallas, Tex., May 2-5. E. N. Willis, 403 Slaughter Bldg., Dallas.

Middle West Division, N. E. L. A.—Hotel Statler, St. Louis, May 9-11. T. A. Browne, 1519 O St., Lincoln, Neb.

Arkansas Utilities Association—Arlington Hotel, Hot Springs National Park, May 14-16. R. I. Brown, Arkansas Power & Light Co., Little Rock.

American Society of Mechanical Engineers—Pittsburgh, May 14-17. Calvin W. Rice, 29 West 39th St., New York.

National Electric Light Association—Atlantic City, June 4-8. P. S. Clapp, 420 Lexington Ave., New York.

American Association of Engineers—Hotel Hussman, El Paso, Tex., June 4-6. M. E. McIver, 63 E. Adams St., Chicago.

Electrical Supply Jobbers' Association—The Homestead, Hot Springs, Va., June 5-8. E. Donald Tolles, 165 Broadway, New York.

National Electrical Manufacturers' Association—The Homestead, Hot Springs, Va., June 11-15. S. N. Clarkson, 420 Lexington Ave., New York.

Pacific Coast Division, N.E.L.A.—Hotel Huntington, Pasadena, Cal., June 12-15. S. H. Taylor, 447 Sutter St., San Francisco.

Georgia Electrical Association—Savannah, June 14 and 15. J. J. McDonough, Georgia Power Co., Dublin, Ga.

Northwest Division, N.E.L.A.—Portland, Ore., June 19-22. B. Snow, 1208 Spalding Bldg., Portland, Ore.

Canadian Electrical Association—SS. "Richelieu" from Montreal to Saguenay and return, June 20-23. H. M. Lyster, 712 Power Bldg., Montreal.

EASTERN ASSOCIATION OF ELECTRICAL INSPECTORS HAS NEW OFFICERS.—A recent election by ballot for officers of the Eastern Association of Electrical Inspectors resulted as follows: President, C. S. Cahaskie, New York; first vice-president, W. C. Field, Springfield, Mass.; second vice-president, J. P. Rohan, Hartford, Conn.; third vice-president, R. M. Nesbitt, Philadelphia; treasurer, A. W. Hopkins, Springfield. The new secretary is R. Walker, 16 Court Street, Brooklyn. The association voted by a large majority to unite in the formation of an international association.

MONTANA POWER COMPANY'S NEW DAMS.—Completion of the dam and power plant of the Montana Power Company at Black Eagle Falls of the Missouri River is noted in the company's just issued 1927 report. The cost was $1,680,000, 10 per cent under the estimate. This plant utilizes to its full capacity under existing circumstances the first of the series of three falls of the Missouri River near the city of Great Falls and is the company's sixth development on the Missouri. The dam at the outlet of Mystic Lake was also completed, raising the level of the lake 20 ft., increasing the storage and permitting the use of the generating facilities there at full capacity during a longer period of each year.

ARKANSAS POWER & LIGHT COMPLETES MAGUIRE SUBSTATION.—The Cullendale substation of the Arkansas Power & Light Company, recently completed at a cost of a half million dollars, has been named Maguire substation as a tribute to the late W. C. Maguire, who was a member of the Arkansas Power & Light Company organization for many years. It is situated 3 miles south of Camden and contains four 1,667-kva. transformers, stepping down the voltage from 110,000 to 33,000. The station is operated by remote control. With the transmission lines from the Louisiana line and the rebuilding of the 66,000-volt line from Pine Bluff to carry 110,000 volts, an investment by the utility company of about $750,000 is represented.

HEARING GIVEN ON COOPER'S CLARK'S FORK HYDRO PLANS.—Application for the development of 265,600 hp. at "Z" canyon, on the Clark's Fork branch of the Columbia River in northeastern Washington, has been heard at Newport, Wash., by Major John S. Butler of Seattle, representing the Federal Power Commission. The cost is estimated at $17,600,000. No conflict arose in the testimony of county officials, the Columbia Basin project officials and local residents. The Pend Oreille Lead & Zinc Company, however, claimed

prior right in behalf of its proposed development of a site at Metaline Falls, just above the "Z" canyon site. The mining company's site would be flooded by Cooper's development. (See ELECTRICAL WORLD, March 3, page 474.)

GREAT NORTHERN POWER COMPANY WILL START FIRST UNIT IN APRIL.—The project of the Great Northern Power Company, which hopes ultimately to develop 160,000 hp. on streams in Snohomish County, Wash., and wants to serve the city of Seattle until the Skagit plant is able to carry all the load, is going ahead, according to the president of the company, J. E. Wickstrom. A 1,200-hp. unit at Gold Bar is to go into service in April, with 40 per cent of the output already contracted for. A primary rate of 2 cents for the first 5,000 kw.-hr., with a large-power rate of $22 a horsepower, is predicted when the new development gets under way. The company will go into new territory, Mr. Wickstrom says, and not compete either with the city of Seattle or the Puget Sound Power & Light Company.

SASKATCHEWAN GOVERNMENT AIMS AT PUBLIC OWNERSHIP.—Through legislation to be introduced at the present session of the Provincial Legislature the Saskatchewan government will seek authority to construct and operate central electric power plants, erect high-tension transmission lines and transformers, expropriate existing power plants and transmission lines and other equipment at its replacement value and sell energy, electrical appliances and equipment to urban and rural dwellers. George Spence, Minister of Railways, Labor and Industries, made this announcement, which met with general support in the Legislature. In the meantime the Montreal Engineering Company is going ahead with the construction of more than 300 miles of transmission lines in the province this year. In the neighboring Province of Alberta another 500 miles of line will be built.

NEW ST. LOUIS STREET-LIGHTING CONTRACT GOES TO WESTINGHOUSE.—A contract amounting to $2,250,000, said to be the largest single award ever made for a street-lighting improvement, has been made with the Westinghouse Manufacturing & Electric Company by the city of St. Louis. The contract is the fourth to be awarded in connection with the city's eight-million-dollar street-lighting project, and the area to be lighted includes the downtown district as well as a number of thoroughfares intersecting the city. The Westinghouse company will furnish the equipment, which will include 4,500 hollow-spun granite standards of special design with a height on the major thoroughfares of 24 ft. and supporting twin lighting units. Single-light standards having a height of 18 ft. or of 13 ft. will be installed on the streets which carry lighter traffic. The installation must be completed on Dec. 8.

Commission Rulings

CONDITIONS MODIFYING OBLIGATION OF COMPANY TO EXTEND SERVICE.—Setting up two principles—first, that an electric utility should extend its lines to render service within the territory which the company undertakes to serve if the extension can be made without placing any undue burden on the company's other patrons; second, that it should not be required to make a comparatively large investment necessary for service to a group of new patrons without some assurance of reasonably adequate revenue for a definite length of time—the Maine Public Utilities Commission ordered the Central Maine Power Company to extend a 2,300-volt line about 6 miles to serve complainants living in a fairly prosperous and well-settled community within the company's territory, on condition that an adequate gross annual revenue fixed by the commission be guaranteed for five years. Subject to the payment of this guaranty, rates were to be in accordance with the company's published schedule.

PRINCIPLES GOVERNING APPROVAL OF CONSOLIDATIONS.—In granting authority to the Central Maine Power Company to absorb the Bethel Light Company, the Black Stream Electric Company, the Fryeburg Electric Light Company and the Western Maine Power Company, the Maine Public Utilities Commission reiterated a former statement of the considerations which govern it in passing upon such applications. These are: (1) the legal right of the purchaser of the new corporation or utility to acquire and hold the property affected by the consolidation; (2) the probable effect of the consolidation with reference to service in the territory affected; (3) the probable consequences of the sale, so far as the interest of the public is concerned with reference to rates, and any other particulars by which the public might be affected, including: (a) petitioner's capacity to serve its present territory, (b) to meet its obligations to present security holders, (c) improvement of service, diminution of cost of management and operation.

COOKING RATE MUST NOT BE EXTENDED TO OTHER USES BY MEANS OF RANGE OUTLETS.—The North Dakota Board of Railroad Commissioners has ordered discontinued the practice of the Otter Tail Power Company at Devil's Lake of offering a special rate for stoves having outlets for other electric appliances such as flat-irons and washing machines, thus obtaining the low cooking rate for energy used by these. The decision resulted from the protest of a steam laundry and other consumers that they were paying far more for power than domestic consumers paid for electricity for cooking and other uses. The cooking rate was shown to be 4 cents per kilowatt-hour, while the power rate paid by the protestants began at 7.77 cents, grading downward. A low rate for cooking to develop business was held by the commission to be a sound practice. It was further held, however, that "the consumers of Devil's Lake and other cities who have purchased and operate electric ranges upon representations by the utilities that they could attach all appliances and obtain preferential rates have been made parties to a practice which we believe results in discrimination." The commission added: "We respectfully direct the attention of the electric utilities to this recommendation and request their earnest consideration with a view to voluntarily taking action. Should the desired result remain unaccomplished, we shall have no alternative but to investigate upon our own motion." A solution suggested by the board but not incorporated in its order was that three separate rates be substituted for the cooking rate now in use. The first would be the present cooking rate and would apply to stoves having no outlets to which appliances could be attached; the second would be a rate for electric stoves with such outlets and would cover energy used for such appliances as well as for cooking; the third would be a combination lighting and cooking rate and would apply to all energy used in the household. It was specified that the rate for the second class of service should compare favorably with the power rate.

Recent Court Decisions

POLICE POWER OF STATE UPHELD IN OKLAHOMA.—The Oklahoma Supreme Court, in Galbreath vs. Oklahoma Natural Gas Company, has sustained the power of the commission to modify as to rates the terms of a contract or franchise made by a municipality with a public utility. The suit was filed originally on behalf of the city of Tulsa and various citizens, but the city and all except three of the individual complainants withdrew. The plaintiffs sought recovery of large sums of money which it was alleged had been collected from Tulsa citizens in violation of the contract with the company after the commission had authorized an increase in the rate. The Supreme Court, quoting the state constitution, said: "The Corporation Commission has power to regulate the charges for public services by municipal corporations. Such power is inherent in the state and is a necessary attribute of sovereignty."

INSTRUCTION IN DAMAGE SUIT REQUIRING PLAINTIFF TO PROVE ABSENCE OF CONTRIBUTORY NEGLIGENCE HELD ERROR.—Declaring that in federal courts the burden of proving contributory negligence is on defendant, whether or not the trial is held in a state holding that the burden is on plaintiff, and that an instruction in the trial court requiring plaintiff to prove the absence of such negligence by the preponderance of evidence was erroneous, the United States Circuit Court of Appeals in West Virginia reversed a verdict for the defendant in Dunagan vs. Appalachian Power Company, a suit asking damages for the death of a man who had charge of an electric fan in a stable and endeavored to stop a leakage of electricity by pulling a switch on a pole outdoors. Evidence showing that after the accident the company grounded a fence which was supposed to have produced a short circuit through the victim's body was properly excluded, the federal court held; but an instruction to the effect that the defendant was not negligent if the lines were properly constructed and equipped was erroneous in ignoring the duty of inspection. (23 F. [2d] 395.)*

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

News About Men of the Industry

G. C. Ward Named Executive Vice-President

George C. Ward, vice-president in charge of engineering and construction for the Southern California Edison Company, was made executive vice-president at the recent annual meeting of the board of directors. Though born and educated in the East, Mr. Ward's chief engineering achievements have been tied in with the development of the great hydro-electric potentialities of California, his adopted state. Since 1912, when the Big Creek-San Joaquin River project of the Southern California Edison Company was first conceived, he has been actively interested in the

G. C. Ward

work and his guiding hand has been apparent from the very beginning. His outstanding accomplishment in connection with this enormous task was the successful completion of the 13-mile Florence Lake tunnel through the solid granite of the Sierras. In recognition of his endeavors he was presented with a bronze medallion by the United States Chamber of Commerce in December, 1925.

Mr. Ward was born in White Plains, N. Y., and after being graduated from Phillips Andover Academy he engaged in railroad location and survey work for the Raquette Lake Railroad in New York State. Until 1906 he was continuously connected with railroad and bridge building and it was during this period that he became associated with Collis P. Huntington and Henry E. Huntington. It was at the instigation of Henry E. that he transferred his interests to California. When the Pacific Light & Power Corporation, of which he was vice-president, was consolidated with the Southern California Edison Company Mr. Ward became vice-president.

SELBY SUMMERS has resigned his position with the distribution engineering department of the Utica (N. Y.) Gas & Electric Company to enter the engineering department of the New York Power & Light Corporation at Schenectady.

SAMUEL INSULL, JR., has been elected a director of the Commonwealth Edison Company, Chicago, to fill the vacancy caused by the recent death of Watson F. Blair.

T. S. SLOAN, formerly connected with the Central Georgia Power Company, Macon, has resigned to become division manager of the Georgia Power Company at Rome.

HON. MAYLAND MORSE, formerly Assistant Attorney-General of New Hampshire, has been appointed a member of the Public Service Commission of that state.

OWEN D. YOUNG, chairman of the board of directors of the General Electric Company, sailed for Europe March 24 abroad the French liner *Paris* for his annual pleasure trip abroad. Most of his visit will be spent in England.

LAWRENCE PALK, formerly assistant to the president and secretary of the Winnipeg Electric Company, Winnipeg, Man., has been appointed assistant general manager in charge of executive matters. Mr. Palk will continue in the capacity of secretary.

HERBERT SOUTHWORTH has been appointed superintendent of the Bristol County (R. I.) Gas & Electric Company, succeeding Abel Reynolds, who recently became general manager and treasurer of the New England Water, Light & Power Associates. Mr. Southworth was formerly employed by the New England Telephone & Telegraph Company at Providence, and since 1923 has been an engineer in the power sales department of the Narragansett Electric Lighting Company of that city.

PROF. H. B. WALKER, head of the department of agricultural engineering at Kansas State Agricultural College, Manhattan, and since 1910 a member of the faculty of that institution, has resigned to accept a similar position with the agricultural branch of the University of California at Davis. He will leave Kansas June 1. Professor Walker has taken a most active interest in the work of the Kansas Committee on Relation of Electricity to Agriculture since its formation, serving as secretary and treasurer from the time the committee was organized. With the establishment of the rural electrical laboratory, embracing nine electrified farms near Larned, Kan., Professor Walker was also made state supervisor of the committee. Active in many projects involving a mutuality of interest between power companies and agricultural leaders, Professor Walker has come to be well known to the public utility industry of the Middle West.

William Baurhyte Resigns

William Baurhyte, president of the Los Angeles Gas & Electric Corporation for the past four years, has resigned, effective March 31. Mr. Baurhyte's retirement as chief executive of the Los Angeles utility brings to a close an association which covered a period of 25 years. Starting in the office of second vice-president, he retained that position until 1913, when he assumed the duties of vice-president. Mr. Baurhyte's valuable services won the recognition of the company's officials and in 1921 he was named vice-president and general manager. When the office of president became vacant through the retirement of

William Baurhyte

W. B. Cline, in the spring of 1924, Mr. Baurhyte was the logical selection for a successor. Mr. Baurhyte was also a member of the board of directors. ADDISON B. DAY, executive vice-president and general manager, has been named president.

J. H. HENDERSON, who served as commerce counsel of the Iowa Railroad Commission from 1911 to 1927, when he was succeeded by Dwight N. Lewis, has been reappointed to that position. Mr. Lewis recently resigned.

ROBERT B. GROVE, assistant secretary of the United Electric Light & Power Company, New York, since 1925, has been elected secretary to succeed the late William J. Meyers. Mr. Grove has been identified with the United organization since 1907 and has served successfully as draftsman, general assistant in the engineering department, assistant to the electrical engineer, assistant to the vice-president and general manager and assistant secretary. When he was made assistant secretary, in 1925, he retained his former title and duties as assistant to the vice-president and general manager, in which capacity he still serves. Mr. Grove has always been an ardent worker for the National Electric Light Association, at the pres-

ent time being vice-chairman of the Accounting National Section, secretary of the lamp committee, assistant traffic manager and a member of the industrial relations committee.

EDGAR L. HARTPENCE has been elected vice-president of the Acme Wire Company, New Haven, Conn., to succeed Leonard S. Taylor. Mr. Hartpence also succeeds Victor M. Tyler as general manager. Mr. Tyler, however, continues as president of the company.

GEORGE F. MITCHELL, treasurer of the Midland Utilities Company, Chicago, since its formation, five years ago, was elected a vice-president at a meeting of the board of directors, and WILLIAM A. SAUER, comptroller during that period, has also been elected to a vice-presidency. Both these new executives have also been elected to the board of directors.

E. OGDEN KETTING, formerly assistant secretary of the Commonwealth Edison Company and for several years secretary to Samuel Insull, president, has left for England to become joint managing director of Insull, Son & Company, Ltd., of London. He has also been elected a vice-president of Insull, Son & Company, Inc., of Chicago and New York.

KINSEY M. ROBINSON, engineer for the Payette division of the Idaho Power Company, has been appointed manager of that division to succeed J. D. Orr, who has been transferred to the Twin Falls division. Mr. Robinson has been identified with the Idaho Power Company and its predecessor, the Idaho-Oregon Light & Power Company, since 1911.

L. B. HARVEY has been elected president of the Porcelain Insulator Corporation, Lima, N. Y., succeeding his father, W. F. Harvey, whose death was announced in these columns several months ago. Mr. Harvey is a graduate of Georgetown University and since leaving college has spent the greater part of his time with the Porcelain Insulator Corporation in various capacities.

JOHN L. BURNS, formerly assistant to president of the United Gas Improvement Company, Philadelphia, has been promoted to the position of manager of the insurance and personnel department of the company. Mr. Burns became identified with the United Gas Improvement Company in 1926, when Arthur W. Thompson was named president of that utility. Previously he had been associated with Mr. Thompson for twenty years in public utility work.

C. H. SPIEHLER, mechanical engineer of the Columbia Engineering & Management Corporation for the past year and a half, is now in charge of the engineering staff for the electrical properties of that corporation with headquarters in Cincinnati. Following graduation from the Massachusetts Institute of Technology in 1908, Mr. Spiehler joined the Rochester Railway & Light Company in the capacity of heating engineer. Two years later he removed to Dayton, Ohio, where he became affiliated with the Dayton Power & Light Company, at first as heating engineer, subsequently as mechanical engineer and then as superintendent of power stations. He entered the employ of the Columbia Engineering & Management Corporation in August, 1926.

O. J. Shaw Resigns

O. J. Shaw has resigned as vice-president of the Iowa-Nebraska Light & Power Company to devote his time to private interests. He is president of the Lincoln Oil Company and Lincoln Insulating Company. He will retain offices in the headquarters building at Lincoln and will remain in an advisory capacity with the company.

Mr. Shaw has been connected with Lincoln public utilities for the past eighteen years, starting as head of the electric lighting department of the Lincoln Traction Company. Subsequently he became assistant secretary and later was placed in charge of the overhead distribution system, power plant operation and steam heating system. Then he was made secretary and in 1919 general manager, the position he occupied when the United Light & Power interests took over the property. Following the consolidation of the Lincoln Traction with the Lincoln Gas & Electric Mr. Shaw became general manager of the Lincoln Public Service Company, predecessor of the Iowa-Nebraska Light & Power Company. Previous to his experience in Lincoln Mr. Shaw was manager of plants at Aurora and Harvard. He graduated from the electrical engineering department of the University of Nebraska in 1907.

O. J. Shaw

EDWARD L. GAY has been appointed manager of the Keene district of the Public Service Company of New Hampshire, succeeding the late Ralph D. Smith. Mr. Gay is a native of Keene and has been in the employ of the Keene district company most of his business life. He entered the service as a bookkeeper, in time becoming assistant treasurer, and later devoting his time to handling the securities of the Public Service Company in the Keene district.

Obituary

JAMES E. JOHNSON, president of the Canton Electric Light & Power Company, Canton, N. Y., died suddenly March 18 at his winter residence in St. Petersburg, Fla.

GEORGE L. GIBSON, formerly purchasing agent of the Rutland (Vt.) Railway, Light & Power Company, Clyde River Power Company, Hortonia Power Company and Vermont Hydro-Electric Corporation, died at Rutland March 25 at the age of 54.

WOLCOTT REMINGTON, vice-president and director of the Thomson Electric Welding Company, Lynn, Mass., died at Lynn March 20 following an illness of a week. He was a graduate of the Massachusetts Institute of Technology. Mr. Remington was cited by the British Government and given a medal of honor for his services in the World War in munitions production.

GAETANO LANZA, engineer, died at his home in Philadelphia March 21 in his 79th year. Dr. Lanza was for 40 years affiliated with the teaching staff of the Massachusetts Institute of Technology, in 1911 having become professor emeritus of mechanics. He was born in Boston and received his education in Virginia. Before his connection with the Massachusetts Institute of Technology Dr. Lanza was assistant instructor at the University of Virginia.

E. W. CAMERON, electrical engineer of Buffalo, N. Y., died suddenly March 18 while on a visit to New York. Mr. Cameron was 55 years of age.

WILLIAM F. M. GOSS, formerly dean of the College of Engineering at the University of Illinois and president of the Railway Car Manufacturers' Association for ten years, died March 23 at the Waldorf-Astoria Hotel, New York. Dr. Goss is probably best known to the electrical industry for his work as a member and later as chief engineer of the Chicago Association of Commerce committee on smoke nuisance and the electrification of railroad terminals in Chicago. In the course of his academic career he organized the department of practical mechanics at Purdue University, with which institution he was connected for seventeen years, being dean of the engineering school for a large portion of that time. In 1907 he became dean of the College of Engineering of the University of Illinois, but ten years later he severed his connection with that faculty to take up the duties of president of the Railway Car Manufacturers' Association. Dr. Goss was quite active in association work, having been a president of the American Society of Mechanical Engineers, a fellow of the American Association for the Advancement of Science, a member of the Society for the Promotion of Engineering Education and of other engineering associations. He was a native of Massachusetts and a graduate of the Massachusetts Institute of Technology.

Financial and Statistical News

Price Levels Unchanged Few Discount Bonds

FEW changes of any importance took place in the prices of power and light common stocks during the week, market interest being centered, for the moment, in more speculative issues. Prices have been firm, however, with the trend upward.

Power and light company bonds have been firm with several price rises. A feature of these issues is the exceedingly large proportion of prices showing a premium. Discount bonds are becoming difficult to find.

Engineers Public Service Leads New Issues

During the past week the Engineers Public Service Company issued 320,000 shares of $5 dividend convertible preferred stock at $100 per share to yield 5 per cent. Proceeds will be applied with other funds toward the retirement of the entire outstanding 311,662 shares of $7 dividend preferred stock at $110 per share and accrued dividends. This refinancing plan will effect a reduction in annual preferred dividend requirements of $581,634.

Gold debentures of the Iowa Public Service Company were offered at 95 and accrued interest, to yield about 5.30 per cent, a piece of financing involving a total of $1,500,000.

The United Public Utilities Company issued 35,000 shares of $6 dividend series preferred stock at $94.50 per share and accrued dividends, yielding about 6.35 per cent.

The North Continent Utilities Corporation made an offering of first lien and refunding gold bonds, series A, totaling $3,500,000, the price being 97 and interest, to yield about 5.75 per cent.

One foreign issue appeared during the week, the million-and-a-half-dollar loan floated by the Municipal Gas & Electric Corporation of Recklinghausen, Germany. The offering was in the form of first mortgage twenty-year sinking fund 7 per cent gold bonds.

DUQUESNE LIGHT STOCKHOLDERS APPROVE CHANGES IN SET-UP.—Stockholders of the Duquesne Light Company approved the changes in capitalization outlined in the Jan. 21 issue of the ELECTRICAL WORLD. They voted to change the authorized common stock from 250,000 shares (par $100) to 1,000,000 shares of no par value. At the same time they increased the number of shares to 4,000,000. There was also approved an issue of 5 per cent cumulative first preferred stock amounting to $50,000,000.

Critical Investor Buys Utility Stocks

ONE of the largest and most critical institutional investors in America—the Sun Life Assurance Company of Canada, with assets of more than $400,000,000—evidently has few misgivings about the standing of American public utility company securities. In its list of holdings appear common stocks of such companies as Commonwealth Edison, Consolidated Gas of New York, Detroit Edison and Public Service of New Jersey, totaling $21,299,903. The same list shows $20,573,445 of preferred stocks, the great bulk of which are of United States utilities. Its utility bond holdings total $27,114,464, of which at least $17,000,000 are bonds of public utilities in the United States.

January Revenue Establishes New Peak

Energy Output for Electric Light and Power Companies Close to 6,700,000,000 Kw.-Hr.—Revenue $172,400,000, Increase of 3.9 per Cent Over December Earnings

A CONTINUOUS upward trend is reflected in reports of operations of electric light and power companies for January. The energy output, 6,699,748,000 kw.-hr., was nearly as great as in December, notwithstanding the seasonal decrease in the lighting load. The operating revenue rose to $172,400,000, computed for 100 per cent of the industry by including estimates for missing reports. This is 3.9 per cent in excess of the earnings for December and thus establishes a new record. The returns also indicate an increase of 7 per cent compared with January, 1927, which is rather better than the average increase in October, November and December. Operating expenses, exclusive of interest, taxes, depreciation or deductions for sinking funds, amounted to $66,200,000; the increase in this item over January, 1927, was 4.6 per cent and was

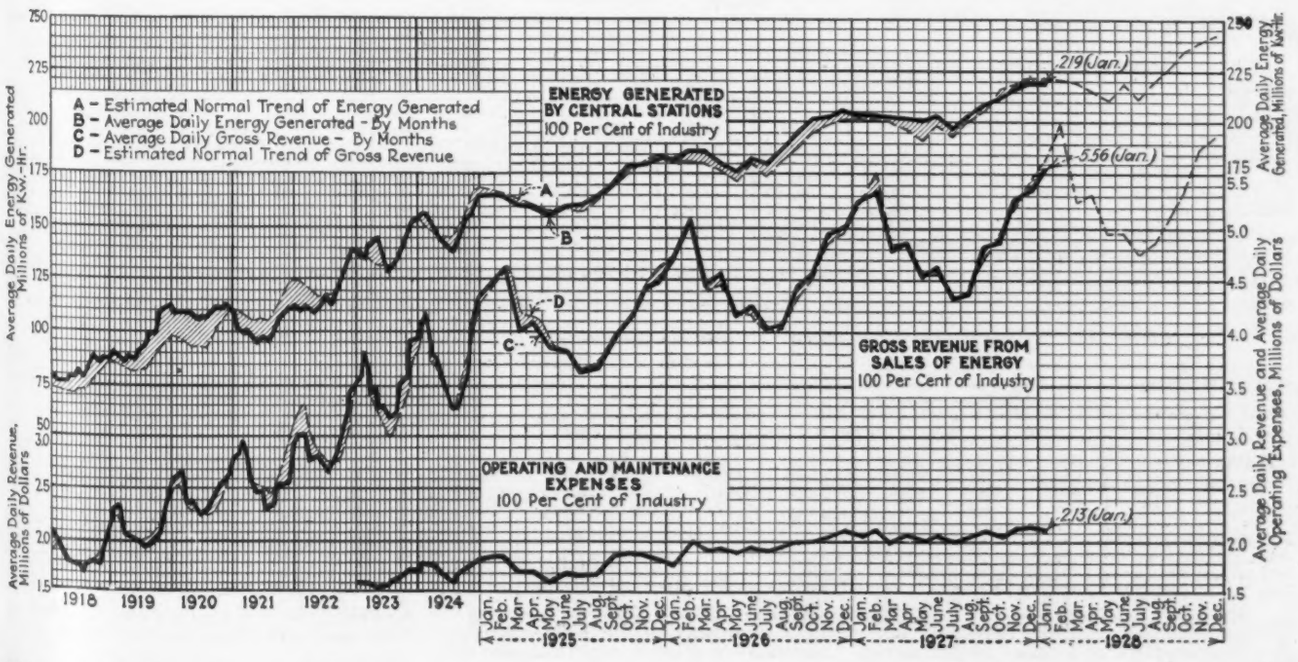

A – Estimated Normal Trend of Energy Generated
B – Average Daily Energy Generated – By Months
C – Average Daily Gross Revenue – By Months
D – Estimated Normal Trend of Gross Revenue
ENERGY GENERATED BY CENTRAL STATIONS
100 Per Cent of Industry
GROSS REVENUE FROM SALES OF ENERGY
100 Per Cent of Industry
OPERATING AND MAINTENANCE EXPENSES
100 Per Cent of Industry
2.19 (Jan.)
5.56 (Jan.)
2.13 (Jan.)
Average Daily Energy Generated, Millions of Kw.-Hr.
Average Daily Revenue and Average Daily Operating Expenses, Millions of Dollars
1918 1919 1920 1921 1922 1923 1924
1925 1926 1927 1928

Table I—Generation and Distribution of Central-Station Energy in the United States

(100 Per Cent of the Industry)

Month	Kw.-Hr. Generated Monthly *			Estimated Distribution of Energy Generated										Energy Purchased by Public Utilities for Resale, Kw.-Hr.	
				Total Energy Consumption by Central-Station Customers, Kw.-Hr.		Energy Consumed for Lighting, Kw.-Hr.		Energy Consumed for Power, Kw.-Hr.		Energy Sold to Electric Railways, Kw.-Hr.		Energy Used in Intracompany Business, Including Line Losses, Kw.-Hr.			
	1927 Thousands	1926 Thousands	Per Cent Inc.	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands
Oct...	6,577,566	6,174,959	+6.5	5,413,566	4,982,959	1,372,000	1,262,000	3,485,566	3,172,959	556,000	548,000	1,164,000	1,192,000	1,290,000	1,240,000
Nov..	6,517,713	6,063,784	+7.4	5,365,713	4,990,784	1,400,000	1,310,000	3,406,713	3,129,784	559,000	551,000	1,152,000	1,073,000	1,269,000	1,200,000
Dec...	6,815,234	6,375,500	+6.9	5,609,234	5,247,500	1,500,000	1,400,000	3,479,234	3,226,500	630,000	621,000	1,206,000	1,128,000	1,270,000	1,182,000
	1928	1927		1928	1927	1928	1927	1928	1927	1928	1927	1928	1927	1928	1927
Jan...	6,699,748	†6,303,199	†+6.3	5,514,748	5,188,199	1,493,000	1,395,000	3,446,748	3,170,199	575,000	623,000	1,185,000	1,115,000	1,350,000	1,190,000

*Data on "energy generated" are those collected and published by the United States Geological Survey for all public utilities minus such data as are collected on energy generated by electric railway companies, reclamation service and manufacturing plants. The data are, therefore, for the electric light and power industry only.
†1928 figures are only approximately comparable with those for 1927, because of changes in classification of certain plants.

thus relatively smaller than the increase in operating revenue.

Taking into account the growth of the electric light and power industry, as established by statistics covering a considerable number of years, and taking into account also the cycle of seasonal changes as determined from the monthly figures for the past five years, it is possible to estimate the normal income for each month. As shown on the chart, the actual earnings for January are within 2 per cent of the estimated normal.

The increase of revenue for January, 1928, over that for January, 1927, was not confined to any one region, as is evident from the following table:

Region	Per Cent Increase
New England	7.3
Atlantic	6.4
North Central	6.8
South Central	7.2
Western	5.1

The regional increases in energy output followed very closely the ratios prevailing in December. The greatest gain was in the West South Central States, where the output was 20 per cent greater than in January of last year. In the South Atlantic States the increase was 15 per cent. In other parts of the country the gains were smaller, running down to 1 per cent in New England. The output in the Mountain States, chiefly from water power, showed a decrease of 3 per cent, while the Coast showed a change from 6 per cent increase in December to 8 per cent in January.

As in December, the output by the use of water power constituted about 39 per cent of the total; 4,108,994,000 kw.-hr. were generated from fuel, requiring the consumption of 3,304,126 tons of coal, 551,756 barrels of fuel oil and 4,893,386,000 cu.ft. of natural gas.

Associated Gas & Electric Plans Refunding Program

A new 4½ per cent issue of twenty-year debentures of the Associated Gas & Electric Company, amounting to $50,000,000, is being offered directly to the company's security holders, each holder of record March 22 being entitled to subscribe for $20 par of debentures for each share of stock or each $100 principal amount of registered convertible securities held. Proceeds will be used to refund the 5½ per cent and 6 per cent convertible debentures outstanding and in addition to provide funds for the retirement of the preferred stocks of subsidiary companies and for the acquisition of new properties.

General Electric Earned $6.41 Net on Common

Net profits of the General Electric Company for 1927 increased nearly 5 per cent to $48,799,489, although orders received during the year declined 5 per cent. Orders totaled $309,784,623, against $327,400,207 in 1926. Unfilled orders at the end of 1927 were $68,916,000, against $72,297,000, also a decrease of 5 per cent. Net sales billed during the year were $312,603,772, against $326,974,104. The income accounts for the past two years show total income of $51,547,687, against $49,657,295 in 1926.

Selling prices of the company's prod-

Table II—Central-Station Financial Operations for Four Months in the United States

(100 Per Cent of the Industry)

Month	Total Gross Revenue from Sale of Energy†			Estimated Distribution of Gross Revenue								Total Operating and Maintenance Expenses‡	
				Lighting Customers		Power Customers		Electric Railways		Other Public Utilities			
	1927 Thousands	1926 Thousands	Per Cent Inc.	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands
Oct.....	$150,800	$141,800	+6.4	$88,700	$84,100	$45,900	$42,000	$4,600	$4,600	$11,600	$11,100	$64,450	$62,950
Nov.....	158,200	148,300	+6.7	94,300	89,100	47,400	43,200	5,000	4,900	11,500	11,100	64,300	62,450
Dec.....	165,900	154,400	+7.4	100,300	94,400	48,700	43,800	5,100	5,000	11,800	11,200	68,800	63,700
	1928	1927		1928	1927	1928	1927	1928	1927	1928	1927	1928	1927
Jan.....	172,000	161,100	+7.0	103,100	99,200	51,700	45,200	5,800	5,700	11,800	11,000	66,200	63,300

†Aggregate gross revenue from actual consumers, and sales to other public utilities for resale, involving a certain amount of duplication.
‡Do not include interest, taxes, depreciation or sinking fund.

*Table III—Operations of Central-Station Hydro and Fuel Plants in the United States**

(100 Per Cent of the Industry)

Month	Energy Generated						Fuel Consumption								
	Hydro-Plants			Fuel Power Plants			Coal			Oil			Gas		
	1927 Thousands of Kw.-Hr.	1926 Thousands of Kw.-Hr.	Per Cent Increase	1927 Thousands of Kw.-Hr.	1926 Thousands of Kw.-Hr.	Per Cent Increase	1927 Short Tons	1926 Short Tons	Per Cent Increase	1927 Barrels	1926 Barrels	Per Cent Increase	1927 Thousands of Cubic Feet	1926 Thousands of Cubic Feet	Per Cent Increase
Oct.....	2,350,030	2,122,336	+10.7	4,227,536	4,052,623	+4.3	3,332,729	3,317,113	+0.5	483,554	879,929	—45.1	6,424,859	4,872,740	+31.8
Nov.....	2,466,092	2,193,093	+12.4	4,051,621	3,870,691	+4.7	3,236,107	3,193,212	+1.3	484,261	926,916	—47.5	5,630,302	3,975,408	+41.5
Dec.....	2,701,622	2,377,175	+13.6	4,113,612	3,998,325	+2.9	3,339,363	3,406,140	—1.9	624,271	769,518	—18.9	4,805,064	3,685,611	+30.4
	1928	1927		1928	1927		1928	1927		1928	1927		1928	1927	
Jan.....	2,590,804	2,331,140	+11.1	4,108,944	3,972,059	+3.4	3,304,426	3,365,461	—1.8	551,756	786,062	—29.9	4,893,386	3,900,868	+25.4

*As collected by United States Geological Survey. The data are for the electric light and power industry only.

ucts continued downward during 1927 as a result of improved manufacturing methods and keen competition in the industry, according to the annual report just issued.

The balance sheet of the company shows current assets of $252,668,341 and current liabilities of $33,147,449. General reserve was $30,158,263, against $27,696,551 a year previous, and the profit and loss surplus was $115,096,616.

COLORADO UTILITY RETIRES PREFERRED.—First steps have been taken toward the retirement of the outstanding 7 per cent preferred stock of the Public Service Company of Colorado with an offer to convert owners' holdings into preferred or common stocks of the Cities Service Company, the parent organization. Public Service stock will be accepted at 110 as payment for Cities Service shares at their market prices. Approximately $6,400,000 of Public Service 7 per cent preferred is now outstanding and it is believed that as soon as the present offer is withdrawn a call will be issued for the unconverted balance. The stock is callable at 110 on 45 days' notice.

Many Stockholders Added to Public Service of New Jersey

AN INCREASE of 8.1 per cent in gross earnings, against a 12.2 per cent growth the previous year, is disclosed in the annual report of the Public Service Corporation of New Jersey. Net earnings, however, due to an improvement in the operating ratio, are up 11.3 per cent, against 9.4 per cent in 1926. Gross earnings of the system have reached the huge total of $115,005,908, and total assets are $615,460,097.

The corporation reports a very substantial increase in business during the year. Sale of electric current during 1927, exclusive of current furnished the Public Service Railway Company, amounted to 1,233,984,052 kw.-hr., which is an increase of 142,234,480 kw.-hr., or 13.03 per cent. The gain in meters was 77,716, making a total of 781,959 in service at the end of the year. This total exceeds the number of gas meters for the first time. Power sales amounted to 770,756,047 kw.-hr., a gain of 11.36 per cent, while commercial light gained 16.71 per cent and sales for municipal lighting 9.65 per cent. Maximum load amounted to 435,500 kw., against 415,000 kw. in 1926. One of the new contracts is with the Holland tunnels.

Analysis of the Public Service Corporation's earnings statement shows a balance of $9,302,163 earned on common stock. This is the equivalent of $2.30 per share on stock outstanding at the end of the year. A dividend of $2 was paid on common shares.

Capital adjustments during the year include the issue of 576,338 shares of no par common stock, $32,542,100 of 6 per cent cumulative preferred and $3,800 of 7 per cent cumulative preferred stock. Five additional issues of 6 per cent cumulative preferred stock were also authorized. Both these were offered to shareholders and the unsold balance was marketed under the company's popular ownership plan. The corporation purchased during the year 1,975,000 shares of Public Service Electric &

Stock Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday March 27	Low 1928	High 1928
ABITIBI PWR. & PAPER, com., new — no par	79	72	81
Ala. Pwr., $7 com. pf.—no par	113½	114½	115½
Allis Chalmers Mfg.,6% com	121½	115½	125
Aluminum Co. of Amer., com	126½	120	136
Aluminum Co. of Amer., 6% pf	109½	105½	109½
Amer & Foreign Pwr., 7% pf.— no par	106½	105½	108½
Amer. & Foreign Pwr., com.—no par	23½	22½	27½
Amer. Bosch Magneto, com.—no par	24½	15½	24½
Amer. Brown Boveri Elec.†	13½	10½	18
Amer. Brown Boveri Elec., pf. $7	50½	46½	63
Amer. Gas & Elec., 6% pf.—no par.	k109	106½	109
Amer. Gas & Elec., com. †—no par.	137½	117½	145
Amer. Lt. & Trac., 6% pf.	113	116	120
Amer. Lt. & Trac., new com.	194½	170	195
Amer. Pwr. & Lt., 6% pf.	106½	104	109½
Amer. Pwr. & Lt., com. †—no par.	80½	62½	83
Amer. Pub. Serv., 7% pf.	a 97½	99	101
Amer. Pub. Serv., com. †	k 70	70	75
Amer. Pub. Utilities, 7% ptc. pf.	94½	90	95
Amer. Pub. Utilities, 7% pr. pf.	100	94	101
Amer. Pub. Utilities, com.	k 60	60	65
Amer. States Sec., A	a 6½	4	7
Amer. States Sec., B	a 6½	4½	7
Amer. Superpwr., 6% ptc pf.—25	k 30	28½	30½
Amer. Superpwr., 6% 1st pf.	l 103½	....	....
Amer.Sup pwr., Class A†—no par	42½	37	42½
Amer.Sup pwr., Class B†—no par	43½	37½	43½
Amer. Wtr. Wks. & Elec., 6% pf.	k103½	101½	105
Amer. W.W. & E., com. new—no par	57	52½	61
Anaconda Copper cap. $3	56½	53½	59½
Appalachian Electric Pwr., 7% pf.	108	108½	110
Arkansas Pwr., & Lt. 7% pf	107½	108	109½
Assoc. Gas & Elec., $3.50—50	54	....	....
Assoc. Gas & Elec., pf.—$6—ne par.	95	96	98½
Assoc. G. & E., Class A, 10—no par.	48½	47	51½
BABCOCK & WILCOX, 7% com.	117	117½	124½
Binghamton L., H. & P., $6 pf.	107	102	106½
Birmingham Elec., pf.—$7—no par.	109	109½	111
Blackstone Valley G. & E., 6% pf.	m106	106	112
Blackstone Valley Gas & Elec., 10% com.—50	165	132	169½
Blaw-Knox, com.†	c103½	91	105
Brazilian Trac., Lt. & Pwr., $7 com.	f218	....	....
Brazilian Trac., Lt. & Pwr.,com.,new	f 56	....	....
Broad River Pwr., 7% pf.	107	105	107½
Brooklyn Edison, 8% com.	229	206½	235½
Buffalo, Niagara & East. Pwr., $1.60 pf.—25	l 26½	....	....
Buffalo, Niagara & East. Pwr. com. $1.20—no par	l 37½	....	....
CALIFORNIA ELEC. GENERATING, 6% pf.	k 98½	98	101
California Ry. & Pwr., 7% pf.	k135	....	....
Carolina Pwr. & Lt., pf.—$7—no par	l110	109	110½
Central & S. W. Util., $7 pf.—no par	a103½	99½	105½
Central & S. W. Util., pr. in. $7 pf.—no par	a107½	103½	108
Central Ark. Ry. & Lt., 7% pf.	104	105	107
Central Ill. Pub. Serv., $6 pf.	a100	97½	100
Central Ind. Pwr., 7% pf.	a 99½	95	99½
Central Maine Power, 6% pf.	96	96	98
Central Maine Power, 7%	108	109	112
Central Pwr. & Lt., 7% pf.	106	104½	105½
Central States Elec., 7% pf.	112½	104½	114
Century Elec., 6% com.	b140	140	145
Cincinnati Gas & Elec., 5% com.	g 98½	97½	99½
Cities Service, $6 pf.—no par.	l 99½	87	94½
Cities Service, pf. B—no par.	l 9½	8	8½
Cities Service, pf. BB—no par.	l 94	80½	86
Cities Service, com.—20 ex. div.	l 57½	40½	58½
Cities Service, Bks. Shrs.—10 ex. div.	l 28½	22½	27
Cities Service Pwr. & Lt., 7% pf.	k106½	106	109½
Cities Service Pwr. & Lt., 6% pf.	k 98	95	100
Cleveland Elec. Illg., 6% pf.	112	113	115½
Cleveland Elec. Illg., 10% com.	390	350	410
Columbia Gas & Elec., 6% pf.	108½	107½	110½
Columbia G. & E. com. $5—no par.	92	89½	97½
Columbus Elec. & Pwr., $2 com.—no par.	k 72	66	72
Columbus Elec. & Pwr., 7%	113½	....	....
Columbus Ry., Pwr. & Lt., 7%	107	....	....
Columbus Ry., Pwr. & Lt., 7 %pf. B	107½	....	....
Columbus Ry., P.& I.t. com.—no par	k115	....	....
Commonwealth Edison, 8% com.	a179	165	189
Commonwealth Edison, 8% com.	104½	102½	104½
Commonwealth Pwr., 6% pf.	73½	62½	74½
Commonw'th Pwr., $2, com.—no par	120	120	123
Conn. Lt. & Pwr., 8% pf.	116	118	121
Conn. Lt. & Pwr., 7% pf.	104½	101½	104½
Cons. Gas of N. Y., pf.	140½	119½	142½
Cons. Gas of N. Y., com. $5—no par.	e111½	110	113
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6% pf.	e111	110	113
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6½% pf.	e104½	100½	104½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 5% pf.	e 72½	67½	73
Cons. Gas, Elec. Lt. & Pwr. of Balti., com. $3.00—no par.	105	....	....
Consolidated Pwr. & Lt., 7% pf.	104½	105½	106½
Consumers Pwr., 6% pf.	105	106	107
Consumers Pwr., 6.6% pf.	106	106½	108½
Continental Gas & Elec., 7% pr. pf.	k230	240	265
Contl. G. & E. com. $4.40—no par.	35	24	30
Crocker Wheeler, com.†	92	77	90
Crocker Wheeler, 7% pf.			
DALLAS PWR. & LT., 7% pf.	110½	110	111½
Dayton Pwr. & Lt., 6% pf.	108	108½	109½
Derby Gas & Elec., 7% pf.	99	96	100
Detroit Edison, 8% com.	k181½	166½	194½
Dubilier Condenser, com.—no par.	k 3	2½	3½
Duke Pwr., cap.	k140	130	145
EASTERN NEW YORK UTIL., $7 pf.	k110½	111	112½
Eastern New York Util. com.	m 65	....	....
Eastern States Pwr. $7, com.	12½	11½	15½
Eastern States Pwr., pf.	k 97	98	99
East. Tex. Elec., 7% pf.	107	106	109
Edison Elec.of Boston, $12 com.	d270	252	280
El Paso Elec. 7% pf.	113	110	112½
Elec. Bond & Share, 6% pf.	l109½	108½	111½
Elec. Bd. & Sh. Sec., com. $1—no par	l 91½	76	95½
Electric Household Util.†	a 20½	13½	24
Elec. Investors, 6% pf.—no par.	102	101	103½
Elec. Investors, com.†—no par.	46½	40½	48½
Elec. Pwr. & Lt., ctfs. pf.	k108	106½	110½
Elec. Pwr. & Lt., ctfs., 40% pd.	m125½	120½	125½
Elec. Pwr. & Lt., ctfs., com.—no par	38½	28½	39½
Elec. Refrig. cap.†	16½	11½	17½
Elec. Ry. Securities, com.—no par.	6½	....	....
Elec. St. Battery com. $5.25—no par	78½	69	79½
Elmira Wtr., Lt. & R.R., 7% pf.	k106½	104	107
Empire Pwr., ptc.†	31½	27½	35½
Engr. Pub. Serv. $7, pf.—no par.	110½	107	110½
Engr. Pub. Serv., com.—no par.	41½	33	42½
Eureka Vacuum Cleaner, com. $4—no par.	73½	69	79
FAIRBANKS MORSE, 7% pf.	k108	104	110
F.-M., com.—$3—no par.	36½	32½	40½
Federal Lt. & Trac.,com $1.40.	51	42	55
Federal Lt. & Trac., $6 pf.—no par.	103½	98	105
Florida Pwr. & Lt., 7% pf.	105½	104½	107½
Ft. Worth Pwr. & Lt., 7% pf.	l114½	113	114½
GALVESTON-HOUSTON ELEC. 6% pf.	78	75	78
Galveston-Houston Elec., com.	32½	31½	35½
General Cable, Cl. A	76½	56	84½
Gen. Elec. $3 com.—no par.	149½	124	149½
Gen. Elec., special—6%	11½	11½	11½
Gen. Gas & Elec. (Del.) com A $1.50—no par.	41	35½	43½
Gen. G. & E. (Del.) pf. A $8—no par	k124	122½	126½
Gen. G. & E. (Del.) pf. A $7—no par.	k113	108½	113½
Gen. G. & E. (Del.) pf. B $7.	k106	105½	108
Gen. Pub. Serv., $7 cum. pf., no par.	k117	110	120
Gen. Pub. Serv., com., no par.	21	16½	21½
General Public Utilities, $7 pf.	98½	98	99
Ga. Lt., Pwr. & Rys., com.	k 58	55	65
Gt. Western Pwr., 7% pf.	k104	....	....
IDAHO PWR., 7% pf.	104½	109	110½
Ill. No. Utilities, 6% pf.	k 96	96	98
Ill. Pwr. & Lt., 7% pf.	105	103	107
Indianapolis Pwr. & Lt., 6½% pf.	105	102	107½
Indianapolis Pwr. & Lt., $7 pf.	103	100	105
Ingersoll Rand com.	k 91	90	94
Int. Combus. Engr., com. $2—no par	50½	45½	55½
Int. Combustion Engr.,7% pf.	k102	103	105½
Int. Util., Class A—$3.50—no par.	47½	45	51½
Int. Utilities, Class B—no par.	8½	6½	10½
Interstate Pwr., pf.—$7—no par.	102	99	103
Interstate Pub. Serv., 7% pf.	104½	103	106
Iowa Ry. & Lt., 7% pf.	k101	102	103
JERSEY CENTRAL PWR. & LT. CO., 7% pf.	107½	105	107
Johns-Manville, com.†—no par.	115½	111½	125
Johns-Manville, 7% pf.	113½	111½	113½

Stock Exchange: *a*Chicago; *b*St. Louis; *c*Philadelphia; *d*Boston; *e*Baltimore; *f* Montreal; *g*Cincinnati; *k*San Francisco; *l*Pittsburgh; *m*Washington. **k**Bid price Saturday, March 24. *l*Bid price Wednesday, March 28. *m*Latest quotations available. †Dividend rate variable.

Stock Quotations of Electric Light and Power and Manufacturing Companies (Continued)

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday March 27	Low 1928	High 1928
KANSAS CITY PWR. & LT. pf. $7	113¼	111¼	113¼
Kansas Gas & Elec., 7% pf.	*f*109½	107	109
Kentucky Hydro-Elec., 7% pf.	*a*104½	102	104½
Kentucky Sec., 6% pf.	92	94	98
Kentucky Sec., 5% com.	150	140	150
Kentucky Utilities, 6% pf.	*k*103	100	103
LACLEDE GAS LT., 10% com.	*k*220	200	260
Lehigh Pwr. Sec., com.—no par	26½	19½	27½
Long Island Ltg., 7% pf.	111	110½	112½
Long Island Ltg., 6% pf.	107	107	108½
Long Island Ltg., com.†—no par	*k*178	170	185
Los Angeles Gas & Elec., 6% pf.	*h*109½	105½	109½
Louisville Gas & Elec., cl. A. $1.75	30½	28	31½
MAN. ELEC. SUPPLY, cap. $5—no par	56½	50	61
Manilla Elec., com.†—no par	*m* 47	45½	50
Maytag Mfg.,com.50—no par,	32½	30	34½
Memphis P. & L., pf.—$7—no par	*k*108	109	111
Metropolitan Ed., pf.—$6—no par	107½	103	107½
Metropolitan Ed., pf.—$7—no par	109	109	111
Metropolitan Ed., com. $5—no par	*k*150	125	155
Middle West Utilities, 7% pf.	*a*123	116½	124½
Middle West Util., 7% pr. lien	*a*126	125	129½
Middle West Util., com. $7—no par	*a*134	123½	135
Midland Utilities, pr. ln. 6% pf.	*a* 95	94½	97
Midland Utilities, 6% pf. A	*a* 90½	89½	92½
Milwaukee Elec. Ry. & Lt., 7% pf.	*k*104	100	103
Milwaukee Elec. Ry. & Lt., 6% pf.	*k*100	98	101½
Minn. Pwr. & Lt., 7% pf.	*k*108½	107	109
Miss. River Pwr., 6% pf.	*k*108	94	109½
Miss. River Pwr., 3% com.	*k*08	....	....
Mohawk Hudson Pwr., 1st pf.—$7—no par	*k*107½	100	110
Mohawk Hudson Pwr., 2d pf.—$7—no par	*k*104	100	109
Mohawk Hudson Pwr., com.—no par	30½	29½	31½
Montana Pwr., 5% com.	159	102½	167½
Montreal Pwr., 7½% com.	*f* 93	....	....
Mountain States Pwr., 7% pf.	*k*104	97	105
Mountain States Pwr., com.†	17	....	....
NASSAU & SUFFOLK LTG., 7% pf.	109½	98	110½
National Elec. Pwr., A†	*a* 31½	27½	32½
National Lt., Ht. & Pwr., com.	*k* 24	20	30
National, Light, Ht. & Pwr., 5% pf.	*k* 72	70	80
National Pwr. & Lt., pf.—$7—no par	109½	108½	111
National Pwr. & Lt., com.†—no par.	27½	21½	27½
National Pub. Serv., 7% pf.	100½	99	103
National Pub. Serv., 7% ptc., pf.	114	....	....
National Pub. Serv., A com. $1.60—no par	26	22	27½
National Pub. Serv., B com.—no par	28½	24½	30
Nebraska Pwr., 7% pf.	*f*112	110	111½
Nevada-Calif. Elec., com.	*k* 38	33½	42
New Brunswick Pwr., 4% pf.	*k* 62	60	70
New Eng. Pub. Serv., pr. ln. pf. $7.	*k*108	98½	109½
New Eng. Pub. Serv., pf. $7	*k*106	95	108
New Orleans Pub. Serv.—7% pf.	107½	106	110
N. Y. & Queens Elec. Lt. & Pwr., 5% pf.	100	91	100
N. Y. Central Elec., 7% pf.	*k*103½	101	104
New York Power & Light 7% pf.	115½	....	....
New York Power & Light, 8% pf.	*m*114	....	....
Newport News & Hampton Ry., Gas & Elec., 5% com.	*m*109	110	115
Newport News & Hampton Ry., Gas & Elec., 7% pf.	*m*109	110	115
Niagara Falls Pwr., 7% pf.—25.	28½	27½	28½
No. Amer., 6% pf.—50.	*k* 53½	53½	55
No. Amer., com.—10.	65	58½	67
No. Amer. Edison, $6 pf.—no par.	103½	102½	105½
No. Caro. Pub. Serv., pf.—$7—no par	*m*109	93	105
Northeastern Pwr., com.	22½	19½	23
No. N. Y. Utilities, 7% pf.	107	103	109
No. Ohio Pwr., com.—no par.	26½	18	27½
No. Ont. Lt. & Pwr., 6% pf.	*k* 99	94	100
No. Ont. Lt. & Pwr., 4% com.	*k* 72	73	78
No. States Pwr. (Del.), 7% pf.	109½	108½	109½
No. States Pwr. (Del.), 8% com.	135½	123	136½
No. Texas Elec., 6% pf.	55	45	70
No. Texas Elec., com.	16	....	....
OHIO BRASS, com. B $4—no par.	100	89	100½
Ohio Brass, 6% pf.	*k*107	106	111
Ohio Pwr., 6% pf.	106½	104	107½
Ohio Pub. Serv., $6 pf.	*k*102½	95	102
Ohio Pub. Serv., 7% pf.	112	109	111½
Ohio River Edison, 7% pf.	108½	106	109½
Oklahoma Gas & Elec., 7% pf.	113½	106	114
PACIFIC Gas & ELEC., 6% pf.	28½	26½	28½
Pacific Gas & Elec., 8% new com.	47½	43½	49½
Pacific Pwr. & Lt., 7% pf.	*l*110	106	109½
Penn Cent. Lt. & Pwr., $5 pf.—no par	*c* 80½	79½	82
Penn-Ohio Edison, 6% pf. no par	*k* 94½	93	96
Penn-Ohio Edison, 7% pf.	108	106½	109
Penn-Ohio Pwr. & Lt., 7% pf.	109½	99	110
Penn Pwr. & Lt.—$7—no par.	*l*109½	109½	110½
Penn Wtr. & Pwr., $2.50 com., new	*e* 71½	68	72½
Phila. Co., 5% pf.–50.	*k* 46	45½	48½
Phila. Co., 6% pf.—50.	56	52	56
Phila. Co., com.—50.	*k*150	149½	163
Phila. Elec., 8% com.—25.	*c* 59½	55½	60
Portland Elec. Pwr., 7% pf.	102½	100	104½
Portland Elec. Pwr., 6% pf.	94	78	96
Portland Elec. Pwr., 6% 2d pf.	80	55	88
Portland Elec. Pwr., com.	51	....	....
Potomac Elec. Power, 6% pf.	*l*112½	....	....
Pwr. Sec., pf.—no par.	*k* 65	50	68
Pwr. Sec., com.—no par.	*k* 12	5	15
Public Serv. of Colorado, 7% pf.,	*l*105	....	....
Pub. Serv. of N. J., 6% pf.	107	103½	107½
Pub. Serv. of N. J., 7% pf.	120	118	120½
Pub. Serv. of N. J., $2 com.—no par	47½	41½	47½
Pub. Serv. of No. Ill., 6% pf.	*a*115	110	115
Pub. Serv. of No. Ill., 7% pf.	*a*119½	119	121
P. S. of No. Ill., com. $8—no par.	*a*172	159½	180
Pub. Serv. of No. Ill., $8 com.	*a*174	159½	180
Pub. Serv. of Okla., 7% pr. ln.	*k*106½	100	107
Pub. Serv. Elec. & Gas, 6% pf.	109½	108	110½
Puget Sound Pwr. & Lt., 7% pf.	109½	109	113
Puget Sound Pwr. & Lt., 6% pf.—no par.	99	92	99½
Puget Sound Pwr. & Lt., com.	57½	34½	63½
RADIO CORP. OF AMER., $3.50 pf.—50.	56½	54½	57½
Radio Corp. of Amer., com.—no par.	169	85½	169
Rhode Island Public Service, pf. $2—no par.	31½	30½	31½
Rochester Gas & Elec. 6% pf. D.	105	105½	106½
Rochester Gas & Elec., 7% pf. B.	107	105	107
Rochester Gas & Elec., 6% pf. C.	105½	105½	106½
SAN JOAQUIN Lt. & Pwr., 7% pr. pf.	*k*116	110	117½
St. Joseph Ry., L., H. & P., 5% pf.	*k* 75	70	75
Servel, Inc.	7	4½	7½
Sierra Pacific Elec., 2% com.	35½	29	38½
Sioux City Gas & Elec., 7% pf.	107½	100	108½
Southeastern Pwr. & Lt., pf.—$7 no par.	*k* 109½	....	....
Southeastern Pwr. & Lt., ptc. pf.	*k* 89½	....	....
Southeastern Pwr. & Lt., com.—no par.	46½	40½	48
So. Calif. Edison, 8% pf.	*k* 47	38½	41
So. Calif. Edison, 7% pf.	*k* 29	27½	29½
So. Calif. Edison, 6% pf.	27½	25½	27½
So. Calif. Edison, 8% com.	47½	43½	48½
Southern Cities Utilities, 7% pf.	86	75	86
Southwestern Lt. & Pwr., A $3.	80	60	80
Southwestern Lt. & Pwr., B.	65	60	65
Southwestern Lt. & Pwr., $6 pf.	91	88	92½
Southwestern Pwr. & Lt., 7% pf.	*k*111½	103	113
Standard Gas & Elec., 8% pf.	67½	65	68
Standard Gas & Elec., 7% pr. pf.	114½	110½	114½
Standard G. & E., com. $3.50	64	57½	66½
Standard Power & Light, com.	39	29½	45
Standard Pwr. & Lt., 7% pf.	*k*105	103½	106½
Staten Island Edison, pf.—$6—no par.	102½	99	103½
Superheater, $6 com.—no par.	164	162	175
Syracuse Lighting, 7% pf.	*k*110	103	111
Syracuse Lighting, 8% pf.	*k*117½	114	119
TAMPA ELEC., com. $2.	*k* 65	62	65
Tenn. Elec. Pwr., 6% pf.	103	92	103
Tenn. Elec. Pwr., 7% pf.	108½	107	110
Terre Haute, Ind. & East. Trac., 5% pf.	*k* 10	....	....
Terre Haute, Ind. & East. Trac., com.	*k* 1	1	3
Tex. Pwr. & Lt., 7% pf.	*l*114½	113½	115
Tide Water Pwr., 8% pf.	112	108	112
Timken Roller Bear., com.—$4 no par.	124½	112½	134
Toledo Edison, 7% pf.	*l*109½	....	....
Toledo Edison, 6% pf.	*k*104½	95	105
Toledo Edison, 6% com.	*k*145	120	150
Tri-City Ry. & Lt., 6% pf.	*k* 94	96	102
UNITED GAS & ELEC., 7% pf.	95	98	103
United Gas & Elec. (N. J.), 5% pf.	75	70	77
United Gas Impr., 8% com.—50.	*c*120	111½	120½
United Lt. & Pwr., pf.—$4—no par.	*k* 55	49	56½
United Lt. & Pwr., pf.—$6.50—no par.	*a*101	95	101
United L. & P., com. A .48—no par.	*a* 22	14	22
United L. & P., com. B .48—no par.	*k* 25	19	25
Utah Pwr. & Lt., 7% pf.	*l*112½	109½	112
Utica Gas & Elec., 7% pf.	105	105	106½
Utica Gas & Elec., 8% com.	*k*200	215	225
Utilities Pwr. & Lt., 7% pf.	101	98	103
Utilities Pwr. & Lt., com. A $2.	32	28½	34½
Utilities Pwr. & Lt., com. B $1—no par.	*k* 23½	18½	26½
VERMONT HYDRO-ELEC., 7% pf.	*k*100	95	102
Virginia Elec. & Pwr., 7% pf.	*k*110½	108	111
WAGNER ELEC., 7% pf.	*b*101½	96½	102
Wagner Elec., com.—no par.	*b* 55½	37½	55½
Washington Ry. & Elec., 5% com.	*f*485	....	....
Washington Ry. & Elec., 7% pf.	*f*103½	....	....
Washington Wtr. Pwr., 8% com.	*k*227	175	235
West Penn Elec., 7% pf.	114	109½	114½
West Penn Elec., Cl. A $7.	109½	108½	110½
West Penn Pwr., 7% pf.	115½	114½	116½
West Penn Pwr., 6% pf.	110	109½	113
West Virginia Lt., Ht. & Pwr., 7% pf.	*k* 95	94	100
Western Pwr., 7% pf.	*k*103	98	105
Western States Gas & Elec., 7% pf.	100	100	106
Western States Gas & Elec., com.	38	....	....
Westinghouse Elec. & Mfg., 8% com.—50.	102½	88½	105½
Weston Elec. Instrument, Cl. A $2—no par.	*k* 32	30½	34½
Weston Elec. Instrument, com.—no par.	12½	12½	14½
Wheeling Elec., 6% pf.	*k*105	95	104
Worthington Pump, 7% pf. A.	*k* 49	46½	55
Worthington Pump, 6% B.	*k* 43	41	49½
Worthington Pump, com.	29½	28	34½
YALE & TOWNE com. $5—25.	71	68½	75

Stock Exchange: *c*Chicago; *b*St. Louis; *e*Philadelphia; *d*Boston; *e*Baltimore; *f*Montreal; *g*Cincinnati; *h*San Francisco; *i*Pittsburgh; *j*Washington. *k*Bid price Saturday, March 24. *l*Bid price Wednesday, March 28. *m*Latest quotations available. †Dividend rate variable.

Gas Company and a number of issues of lessor companies.

At the end of 1927 there were 89,769 accounts on the stock ledgers of the corporation, against 67,303, and there were in addition, 18,912 open accounts, indicating an unusually wide distribution of shareholders.

PUGET SOUND COMPANY PLANS RETIREMENT OF 7 PER CENT ISSUE.—At a meeting to be held May 2 stockholders of the Puget Sound Power & Light Company will vote on a proposal to redeem $10,000,000 of 7 per cent prior preferred stock at $110 a share. This will be made possible through the issuance of 110,000 shares of new $5 cumulative no par prior preferred stock. Any required balance will be provided by an additional issue of $6 preferred.

Southern California Edison Votes Change in Set-Up

Stockholders of the Southern California Edison Company, at their annual meeting, March 16, approved an increase in the company's preferred and a decrease in its common stock. The proposal to issue $5,000,000 par-value common stock to employees at not less than par ($25) was also approved. It was decided to decrease the authorized amount of common stock from $125,000,000 to $100,000,000 and to increase the amount of preferred "C" stock from $20,000,000 to $45,000,000.

Of the 6,345,773 shares of stock outstanding, 4,762,173 shares, or some 74 per cent of the total, were voted at the meeting, either in person or by proxy. Only 500 shares of stock voted against the proposal to change the authorized common and preferred stocks, but 600 shares of stock objected to offering common stock to employees.

BRITISH CABLE AND RADIO COMPANIES MERGE. — Britain's Eastern Telegraph Company and associated companies and the Marconi Wireless Telegraph Company have jointly announced a provisional fusion in the form of a holding company, provided the companies negotiate an agreement with the British and Dominion Governments and the shareholders approve, cables Commercial Attaché William L. Cooper, London, to the Department of Commerce. The holding company is capitalized at £53,700,000 of 5½ per cent preference and 7½ per cent ordinary shares.

Business News and Market Conditions

The Electrical Unions and Armored Cable

Rumors have been circulated in the trade that the electrical workers' unions will not permit the use of armored cable in New York. A committee of manufacturers conferred with H. H. Broach, vice-president of the International Electrical Workers' Union, relative to this, and Mr. Broach recently appeared at the district attorney's office, Bronx County, in response to a subpœna issued because of a complaint against such interference. On both occasions Mr. Broach stated that the unions would not take any action to prevent their members from installing armored cable.

The board of governors of the National Electrical Manufacturers' Association has approved recommendations presented by its labor committee as follows:

1. That you urge all members of Nema not already members of the League for Industrial Rights to take out membership in that organization immediately.
2. That all member companies having trouble with organized labor, in so far as it affects the free distribution of their products, at once notify the labor committee of Nema for such action as may seem best, and that the matter may be brought to the attention of other members of Nema.
3. That our representatives on the executive committee of the National Electric Light Association lay before that committee the facts in reference to existing labor conditions and their effect on the industry.
4. That our representatives on the board of governors of the Society for Electrical Development (which is the co-ordinating organization of the entire electrical industry) lay before that board the facts in regard to existing labor conditions, discussing with such representatives from other branches of the electrical industry the situation in detail and its effects on restricting the development of the entire industry.
5. That representatives on the above organizations report to the board of governors of Nema for action at the next meeting.
6. Your labor committee believes that every right and proper step should be taken by Nema to protect the electrical manufacturing industry in the unrestricted distribution of its goods so that an open and free market may be maintained.

Activity Slightly Above Last Year

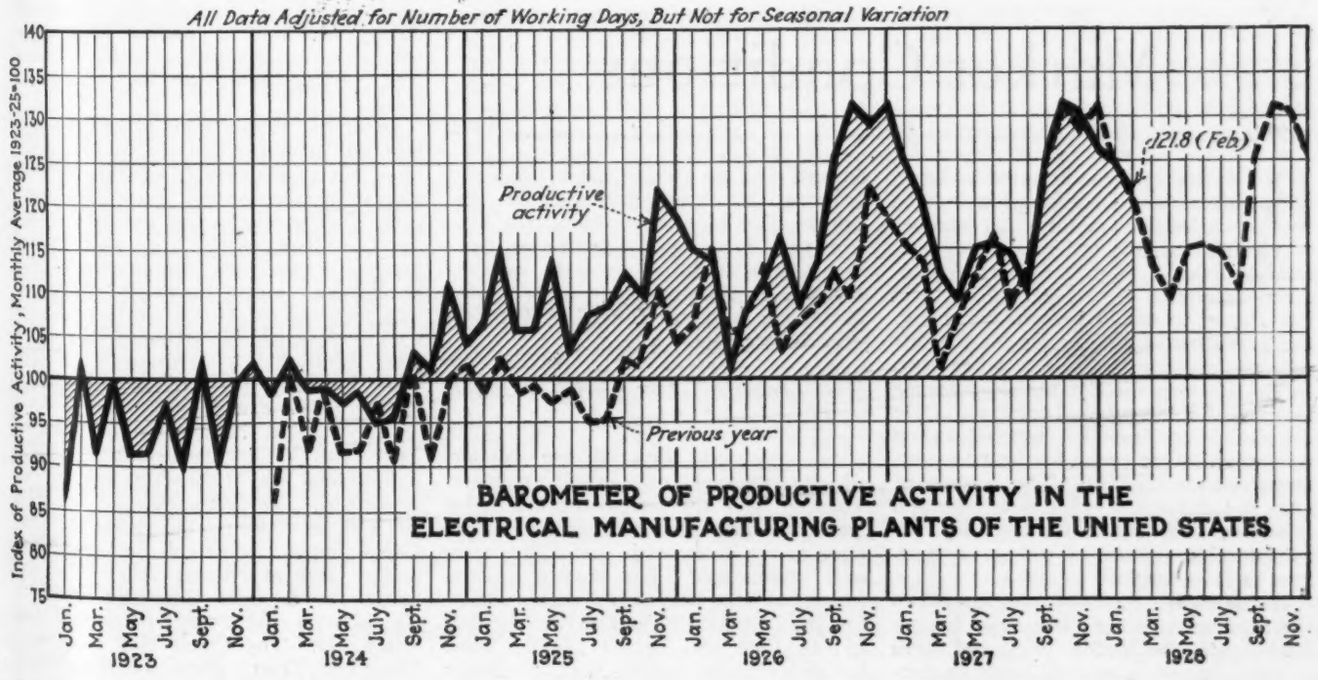
Production in Electrical Manufacturing Plants Holding Up Well—February Rate of Operations 1.2 Per Cent Over 1927

DURING February the electrical manufacturing plants of the nation reported that productive operations were slightly below those of January, but were slightly above those of February last year. Although the operations of the electrical manufacturing plants during the past few months at times have been under those of the same month in the year previous, yet the volume of production for the twelve-month period ended during the current February was about 1 per cent over that during a similar period ending with February last year. The operations of the larger electrical manufacturing companies appear to be holding up materially better than the smaller companies. The February rate of production of the smaller companies was 12.3 per cent under the peak reached last October, while that of the larger companies was actually 4 per cent above the rate of production reported for last October.

The index of activity in the electrical manufacturing industry based on consumption of electrical energy stands at 121.8 for February, as compared with 124.7 for January and 131.3 for the peak month of October. Comparative indexes of productive activity referred to the average activity for the period 1923-25 as 100 and adjusted for number of working days are as follows:

February, 1928	121.8
January, 1928	124.7
December, 1927	125.4
October, 1927 (peak month)	131.3
February, 1927	120.5
February, 1926	113.8

While past history would indicate that it is perfectly normal for the electrical manufacturing plants to reduce their rate of operations gradually from October to about April, general industry in the nation appears to reach its low point normally in December, the first quarter of the year usually witnessing a material increase in activity. This increase during the current year was slightly below that of the first quarter of 1927, but appears to have exceeded that of both 1925 and 1926. The February operations of general industry were about 16.2 per cent over those of last December.



Delinquent Electrical Accounts

(Data Supplied by National Electrical Credit Association)

NUMBER OF ACCOUNTS REPORTED

Division	February 1927	February 1928	Per Cent Increase or Decrease	Two Months 1927	Two Months 1928	Per Cent Increase or Decrease
New York	318	301	—5.35	690	561	—18.7
Middle and Southern Atlantic	149	183	+22.8	286	342	+19.6
New England	152	121	—20.4	264	254	—3.78
Pacific Coast	9	6	—33.3	34	17	—50
Central	877	796	—9.24	1,644	1,594	—3.04
Total	1,505	1,407	—6.51	2,918	2,788	—5.14

TOTAL AMOUNTS REPORTED

Division	February 1927	February 1928	Per Cent Increase or Decrease	Two Months 1927	Two Months 1928	Per Cent Increase or Decrease
New York	$51,216	$39,083	—23.6	$113,509	$88,610	—21.9
Middle and Southern Atlantic States	20,052	27,912	+39.2	34,341	45,423	+32.3
New England	21,327	15,948	—25.2	31,935	30,722	—3.80
Pacific Coast	2,664	1,187	—55.4	3,818	3,120	—18.2
Central	111,024	100,558	—9.43	202,728	201,313	—0.70
Total	$206,883	$184,688	—10.5	$386,331	$369,188	—4.44

AVERAGE AMOUNTS

	February 1927	February 1928	Two Months 1927	Two Months 1928
New York	$161	$129	$328	$319
Middle and Southern Atlantic States	134	152	238	262
New England	140	131	234	242
Pacific Coast	296	197	424	372
Central	127	126	247	252

Hoist Manufacturers Hold Annual Meeting

At the annual meeting of the Electric Hoist Manufacturers Association, held in New York on March 15, N. A. Hall of the Sprague hoist division, Shepard Electric Crane & Hoist Company, New York, was elected chairman of the association, and H. J. Fuller of the Yale & Towne Manufacturing Company, Stamford, Conn., was elected vice-chairman. The American Engineering Company of Philadelphia and the Chisholm-Moore Manufacturing Company of Cleveland were elected to membership. Reports which were submitted at the meeting indicate that electric hoists are now being used in 95 industries. In addition to the regular statistical work of the association, which includes the gathering of information monthly regarding the number and value of hoists ordered, segregated under standard rating sizes, and value of shipments, there has been inaugurated a plan for the collection of information regarding inquiries for hoist quotations. An effort is being made by the association to determine what relation exists between inquiries and orders.

Market Conditions

BUYING in New England is being well sustained with a good demand recorded for motors. A number of electric furnace orders are pending final approval. A prominent manufacturer states that New England business has shown a steady growth and, with the exception of 1920, sales for the last year are greater than in any other year. In the Eastern district the demand for motors was strong and central-station companies continue to buy substation equipment. One order for transformers amounted to $270,000. The volume of sales is satisfactory in the Southeast and is spread over the entire territory. A considerable amount of industrial business is in immediate prospect.

Inquiries are good but sales are off in the St. Louis district. Industrial buying improves in the Middle West and there is little change in general business conditions. On the Pacific Coast industrial ordering is active, although in the Seattle district motor orders are low, with good prospects for future business. Many street-lighting projects are reported. A 200-ton paper mill to cost $6,500,000 is being planned by the Zellerbach interests.

Big Demand for Copper Both Here and Abroad

An enormous demand for copper, which developed to its fullest extent on Tuesday, was the feature of the metal markets. The other non-ferrous metals were fairly quiet, with prices generally well maintained. The copper market, which has been little better than average for the last month, and extremely dull in the East and in the Middle West for many weeks before that, gradually improved until Tuesday, when an avalanche of orders quickly brought every seller up to the full 14⅛-cent Valley quotation. Total sales for the week ended Wednesday have exceeded those of any week since that of Dec. 8, 1926.

Good inquiry and active buying have characterized the domestic lead markets.

NEW YORK METAL MARKET PRICES

	Mar. 21, 1928 Cents per Pound	Mar. 28, 1928 Cents per Pound
Copper, electrolytic	13.78½	13.90
Lead, Am. S. & R. price	6	6
Antimony	10½	9¾
Nickel, ingot	35	35
Zinc spots	6.0½	6.046
Tin, Straits	53¾	53
Aluminum, 99 per cent.	24.30	24.30

Base copper price March 28, 1928, 15½ cents.

Small premiums over the contract price of the American Smelting & Refining Company, which has remained at 6 cents New York, have been obtained, but the tonnage is not sufficiently large to be reflected in quotations. The leading interest, however, during the last two days has been unwilling to entertain business at the 6-cent level for delivery beyond April.

Volume of Sales Satisfactory in the Southeast

Individual orders placed in the Southeast are small. The demand is virtually from the entire territory and the total volume of business is satisfactory. One company in Georgia ordered creosoted pine poles amounting to $3,400 and bare copper wire amounting to $1,800, while two small companies in the same state ordered line construction materials amounting to $2,500 and $1,000, respectively. One of the larger central-station companies received an order for 72 electric ranges for an apartment house installation and the order for 72 electric refrigerators for the same installation is pending and will undoubtedly be placed during the coming week. The same company also received an order for sixteen refrigerators for an apartment house.

Inquiries, rather than orders, constitute the principal activity in industrial lines, but a considerable amount of business is in more or less immediate prospect. Two medium-sized textile mills in the Carolinas, using large amounts of process steam, are contemplating the purchase of steam turbines. An order was received for $1,000 worth of inside wiring materials for a Georgia fertilizer plant addition. A "white-way" system and additional street lights will be installed at Brunswick, Ga.

Construction items are as follows: The Central Georgia Power Company will extend its 11,000-volt line to the American Clay Company, and install a 300-kva. substation. The Alabama Power Company is acquiring the municipal power plant at Athens, Ala. The Atlantic Ice & Coal Company, Atlanta, Ga., plans a cold storage plant at Buena Vista, Ga. The Chase Bag Company, Memphis, Tenn., plans the installation

of a plant addition which is to cost $115,000. The Tubize Artificial Silk Company, Hopewell, Va., plans a new mill to cost $1,000,000. The Orange Textile Mills, Inc., Orange, Va., plans a new mill, to cost $100,000. The Shenandoah Milling Company, Shenandoah, Va., plans a hydro-electric plant on the Shenandoah River to cost $250,000. The Appalachian Electric Power Company plans a substation in the Williamson district, to cost $150,000. The Mississippi Power & Light Company plans a transmission line from Lexington to Durant, Miss. The Carolina Power & Light Company plans a transmission line from Canton to Asheville, with branch to Greenville, S. C., about 70 miles, to operate at 110,000 volts and to cost $250,000. Hickory, N. C., Montgomery, Ala., and Union City, Tenn., are planning ornamental street-lighting systems.

Strong Demand for Motors in Eastern District

Motor sales are decidedly active in the Eastern district. Iron and steel mills, dye and chemical interests, textile mills, metal-working plants, paper mills and the automobile industry are prominent in the demand for equipment. The business in turbine units also is improving and the outlook is encouraging. A dye manufacturing company in New Jersey has placed an order for motors totaling $35,000. A yeast manufacturing concern has contracted for a turbo-generator to cost over $20,000. Chemical interests in West Virginia and Tennessee, now engaged in plant expansion, are in the market for motors and kindred equipment and are expected to place orders at an early date. A shipbuilding company in New Jersey is constructing two large vessels for the Panama Railroad and, while decision is still pending, it is anticipated that electric turbine units will be selected for operation. Business in fractional-horsepower motors is holding up well.

Central-station companies are continuing the purchase of substation equipment. A metropolitan utility has contracted for a quantity of oil circuit breakers and regulators for a local substation. A company in New Jersey has divided an order for 27 transformers, 4,000 kva. each, among three manufacturers, at a total cost of $270,000. Another company placed an order for transformers amounting to $55,000 and for regulators to cost $65,000. A New Jersey utility also has signed a contract for a quantity of high-tension insulators. The demand for insulators has been very sluggish during the past few weeks and still continues spotty. Wire and cable business is lagging, although the prospects for sizable commitments are better. A manufacturer of street-lighting equipment reports an awakening in this line and a number of municipalities in the Eastern district are showing an inclination to make purchases.

Both central station and industrial accounts are fairly active at Philadelphia, although sales are on a reduced basis as compared with this time a year ago. Some of the Pennsylvania power concerns are expected to make early purchases of line equipment and apparatus for substation service. Industrial motors are moving quite actively.

Immediate construction projects in the Eastern district include the following: The A. P. W. Paper Company, Albany, N. Y., plans an addition to cost $1,000,000. The Cortland (N. Y.) County Lighting Company plans line extensions at Preble, Solon and vicinity. The Lockport Light, Heat & Power Company will install a system at Middleport. Albert D. Smith & Company, New York, will build a window shade plant on Staten Island to cost $100,000. The Great Atlantic & Pacific Tea Company, Jersey City, N. J., plans a baking and refrigerating plant at Altoona, Pa., to cost $350,000. A. Schottland, Inc., Paterson, N. J., plans a silk mill at Staunton, Va., to cost $200,000. The Trenton Potteries Company, Trenton, N. J., will build an addition to cost $100,000. Newark, N. J., plans an ornamental lighting system on Hawthorne Avenue. The American Electric Power Company will build transmission lines to Atlantic City and in the vicinity of Wilmington, Del. The Hazleton Heights Silk Company, Hazleton, Pa., plans a mill at Clinton, S. C., to cost $100,000.

Industrial Buying Improves in Middle West

Industrial plant buying is improving in the Middle West. Little change in general business conditions is noted. The automotive and steel industries continue to show improvement. Several of the railroads have placed large orders for equipment, while car loadings indicate a considerable movement of commodities. Utility companies are actively engaged in construction work. An order was placed for 350,000 lb. of copper bar, one for 150,000 lb. of solder and one for 500,000 lb. of triple-braid weatherproof wire. Jobbers' sales are normal. Business is not generally as good in the electrical jobbing line as it was last month at this time.

Construction projects are as follows: The Central Illinois Public Service Company plans an ice plant at Bluford, Ill., to cost $100,000. The Park Air Line Company, St. Louis, plans an aircraft manufacturing plant at East St. Louis, Ill., to cost $100,000. The Fleischmann Company, Chicago, will build a yeast plant at Pekin, Ill., to cost $450,000. Logansport, Ind., plans extensions in its electric power plant. The Iowa Soap Company, Burlington, Iowa, plans a power plant in connection with an addition to its factory to cost $100,000. The Consumers Power Company will build an addition to its steam plant at Grand Rapids, Mich. Willmar, Minn., plans extensions in its municipal power plant. Haskins Brothers & Company, Omaha, Neb., will build an addition to its soap-manufacturing plant, to cost $100,000. The Akron Rubber Reclaiming Company, Barberton, Ohio, will take bids for a new mill at East St. Louis, Ill., to be operated by the Midwest Rubber Reclaiming Company, a subsidiary, to cost about $175,000. The Consolidated Water Power & Paper Company plans an addition to its paper mill at Appleton, Wis., to cost $350,000. The Central Illinois Public Service Company, Springfield, Ill., will serve Laclede, Watson, Mason, Edgewood, Rosamond, Forest City, Topeka, Bishop, Ledford, Rohrer and Dorans. Belleville, Wis., plans an extension of its 6,600-volt line and the construction of a small substation. Janesville, Wis., plans to rebuild the transmission line on the south shore of Lake Ripley. The Wisconsin Power & Light Company, Madison, Wis., plans a transmission line at Clintonville and in the Baraboo district and reconstruction of the line extending from Reedsburg to Pardeeville. Glenview, Ill., Deer River, Grand Rapids and Waseca, Minn., and Lincoln, Neb., plan ornamental lighting systems.

Buying in New England Is Well Sustained

The sales volume in the New England district indicates that buying is steady with increasing symptoms of strength. Particularly is this true of the movement in small motors, which reached an encouraging total of over $50,000. Central-station supplies are moving in small lots and prospects for continued activity are good in view of a number of link-ups planned in Maine and Massachusetts. Wire orders are coming in regularly, and portable electric tools have received some attention. Switch and control apparatus orders have fallen off temporarily and transformers are quiet.

Electric furnaces are being considered by a number of plants and a number of orders are pending final approval. Electric street lighting is active and a list of appropriations amounting to over $100,000 is being considered by a prominent manufacturer. One company states that New England business over the past year was greater than at any time since 1920. Contracts awarded last week reached a total of over $11,000,000. Construction projects are as follows: A hospital under state aid will be erected in Waltham, Mass., at a cost of $1,000,000, and the Boston Ice Company plans an ice plant in Dorchester.

Industrial Ordering Active on Pacific Coast

A week's steady rain on the Pacific Coast has prevented serious crop losses owing to an otherwise dry spring. There are only 42 in. of snow at Summit, the normal being 115 in. Various orders now under consideration include a 100-ton electric crane for Los Angeles, 650 pieces of copper busbars for Glendale, a traffic signal system for Santa Cruz and street lighting projects for Belmont, Willows, Oakland, etc. Industrial ordering is good, comprising such varied business as $3,000 worth of motors for a lumber company, three motion-picture motor-generator sets

amounting to $6,000, 100 washing machine motors, 250 mixing machine motors, a gas-engine-driven arc welding set for a steel company and a complete traffic control system for San Jose. Power company ordering is rather quiet, being limited to maintenance material and supply stock orders. The outstanding machinery order covers two heavy-duty circuit breakers, valued at $3,000 each, for the Bay district.

Although prospects for future business are reported exceptionally bright by Seattle jobbers, sales were at a minimum and were the smallest for any week since the first of the year. A few scattered motor orders, small sizes only, were placed by irrigation companies and orchards. The Puget Sound Power & Light Company placed an order for twelve 75,000-volt oil switches and the city of Seattle issued a call for bids for clearing 700 acres of land for the Diablo reservoir site of the Skagit hydro-electric project. The city of Seattle also called for bids for street lights on Union and other streets, costing in excess of $400,000. Longview, Wash., plans extension of street lights to cost $25,000 and Oregon City during March will award a contract for a system on four streets. The Western Cold Storage Company, Wenatchee, will purchase 350 hp. in motors for one of its plants. The Zellerbach interests are planning a 200-ton paper mill to cost approximately $6,500,000 and to operate in conjunction with the 100-ton pulp mill at Hoquiam now under construction.

Construction projects are as follows: The Salt River Valley Water Users' Association, Phoenix, Ariz., plans an 8,000-kw. hydro-electric power plant in the Stewart Mountain district. The San Diego Gas & Electric Company has approved plans for a substation at Oceanside, Calif. The E. H. Edwards Company, South San Francisco, Calif., will build an addition to its wire rope plant to cost $100,000. The Apple Growers' Cold Storage Company, Watsonville, Calif., will build a cold storage plant to cost $250,000. The Walsenburg Creamery Company, Walsenburg, Colo., plans a cold storage plant. The Midland Counties Public Service Corporation will make extensions in substations and transmission lines at San Luis Obispo, Calif., to cost $30,000. The Southern Colorado Power Company will make extensions in its power plant at Lamar, Colo., and will construct a transmission line from Las Animas to Lamar. Richmond, Sacramento, Orlando, Salinas, Los Angeles and Yreka, Calif., plan installation of ornamental lighting systems.

Inquiries Good But Sales Off in St. Louis District

Manufacturers in the St. Louis district report a slight increase in the demand for stock apparatus. The only important orders placed were one for a lot of eight oil well motors amounting to $75,000, and another for an electric locomotive for one of the Southern railroads at a cost of $28,000. Jobbers report business quiet, but several large jobs are being figured.

Construction projects are as follows: The Southwestern Gas & Electric Company, Shreveport, La., plans a steam power plant on the Little River, near Horatio, Ark., to cost $1,500,000. The Hollywood Public Utilities Company, Shreveport, La., plans a power plant. Marshall, Mo., has voted $80,000 in bonds for an addition to its municipal power plant. The Stewart Inso Board Company, St. Joseph, Mo., will build an addition to its plant to cost $200,000. The New State Ice Company, Oklahoma City, Okla., will build an ice plant on West Main Street. The Southwestern Light & Power Company has acquired the municipal power plant at Thomas, Okla. The Myers-Spalti Manufacturing Company, Houston, Tex., will build an addition to its furniture factory to cost $200,000. The Crystal Oil Refining Corporation, Shreveport, La., plans a new refinery at Monahans, Tex., to cost $350,000. Olton, Tex., plans a municipal power plant. The Texas Utilities Company will build a transmission line from Slaton to Tahoka, Tex., to cost $50,000. Clayton, Noel and St. Joseph, Mo., and Fort Worth and Burnett, Tex., plan ornamental lighting systems.

Activities of the Trade

Bryant Company Acquires Hemco Manufacturing

The plant, real estate, equipment and patents of the Hemco Electric Manufacturing Company of Bridgeport, manufacturer of molded sockets, plates and other composition parts for electrical fittings, has been taken over by the Bryant Electric Manufacturing Company, Bridgeport, Conn. The acquired plant covers 2¾ acres with 70,000 sq.ft. of floor area.

The Hemco products will be made under the same trade name, but the plant will be operated under the Bryant name, and its products will continue to be distributed by former Hemco distributors and also by all Bryant distributors. The line also will be increased. The Bryant company is taking over the entire personnel, including E. B. McKinley, president of the Hemco company.

Joslyn Company Takes Over American Jobbers Supply

The Joslyn Company, Eastern division of the Joslyn Manufacturing & Supply Company, has taken over the interests of the American Jobbers Supply Company of New York with branch offices located in Philadelphia, Boston, and Baltimore. The Joslyn Company will continue to sell the same lines of material formerly sold by the American Jobbers Supply Company, consisting of the Seyler Manufacturing Company's pole line hardware and specialties, the Porcelain Insulator Corporation's "Pinco" high-voltage porcelain insulators, and the Joslyn Manufacturing & Supply Company's poles and complete pole line materials and construction tools.

The Joslyn Company has crossarm factories and complete warehouse stocks of hardware and other supplies at Rutherford, N. J. and Baltimore, Md. E. L. Morier, who was formerly Eastern vice-president of the Naugle Pole & Tie Company, Chicago, has been appointed general manager of the Joslyn Company.

Babcock & Wilcox Gets Order for Deepwater Boilers

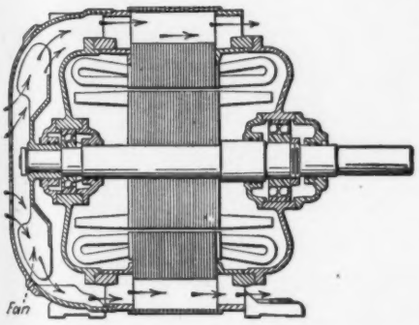
Stevens & Wood, Inc., New York, acting as agents for the American Gas & Electric Company and the United Gas Improvement Company, have placed an order with the Babcock & Wilcox Company for six high-pressure boilers for the new Deepwater plant. Four of these units are standard boilers, 53 sections wide, each section being eight tubes, 3½ in. in diameter and 20 ft. long, the sections being connected to a forged steel drum 4 in. thick, 52 in. internal diameter and 50 ft. 3 in. long. The heating surface of each unit is 9,623 sq.ft. The boilers are to be equipped with Babcock & Wilcox convection superheaters designed to give an ultimate steam temperature of 725 deg. when the boiler is operating at a rate of 331,000 lb. of steam per hour. The boilers will also be equipped with Babcock & Wilcox wrought steel return bend economizers of the steaming type. Each economizer will contain 18,326 sq.ft. of heating surface.

Two of the units are reheat boilers, the boiler sections having the same size and arrangement of heating surface, and are identical with the standard boilers. The superheaters are of the convection type designed to give an ultimate steam temperature of 725 deg. when the boilers are delivering 290,000 lb. of steam per hour. The reheater elements are of the Babcock & Wilcox wrought steel return bend construction, designed to reheat a maximum of 419,000 lb. of steam per hour at an initial pressure of 385 lb., and a temperature of 487 deg. to an ultimate temperature of 775 deg. The reheat boilers are to be equipped with Babcock & Wilcox wrought steel return bend economizers containing 4,763 sq.ft. of heating surface each. Both standard and reheat boilers are built for a working pressure of 1,350 lb.

New Equipment Available

Air-Jacketed Motor

An air-jacketed motor, for use where dust, fumes and moisture are present in sufficient quantities to necessitate protection to the motor, has been developed by the Wagner Electric Corporation, St. Louis. The entire motor, as shown in the illustration, is surrounded by a jacket open at both ends with fan blades on a shaft extension, between the sealed motor and its outer jacket. The only clearance between rotating and stationary parts of the motor is in the bearing housing. The motors are new in external construction only, the company stating that no change has been made in the electrical principles. The end shield is made of cast iron, rib-reinforced, and has a substantial grating which protects the fan and provides an opening for incoming ventilating air. The center



Inclosed motor with air jacket and ventilating fan

shield is made of heavy sheet steel held in place by slot head bolts. The fan is of one-piece construction. The conduit box is mountable in four positions. The exposed outer rim of the stator is deeply grooved to increase radiation surface, and the stator laminæ are welded together to lessen vibration and reduce magnetic noises.

The motors have a double row of ball bearings, self-aligning in one end plate and deep groove in the other to take end thrust. Bearings are grease lubricated and sealed in a dustproof housing. The shafts are made slightly longer than those for standard motors to permit mounting the fan. Single-phase repulsion-induction motors may be had in sizes from 1 hp. to 20 hp. and polyphase squirrel cage motors in sizes from 2 hp. to 30 hp. These motors are designed for a temperature rise not to exceed 50 deg. C. and to meet all A.I.E.E. and N.E.L.A. standards.

MICROAMMETER.—A microammeter of the semi-suspended type is being marketed by the Rawson Electrical Instrument Company, Cambridge, Mass. This instrument is furnished to meet the demand for a portable calibrated meter reading excessively small current values. In this device, known as the type 503, full scale sensitivity is obtained with a current of 0.5 microampere. The scale is about 5 in. long, each division representing 0.005 microampere.

Stroboscope

An electrically operated stroboscope, for determining the angle of lag of synchronous machine rotors under load, has been devised by engineers of the General Electric Company. The new device employs no moving parts or tachometers. It operates by means of a small neon-gas lamp, which gives flashes of light lasting less than one-fifty-thousandth of a second each, and thus illuminates a white line on a stroboscopic disk fixed to the rotor shaft of the machine under test, for so short a time that the line appears to be standing still. Fixed concentrically with the disk, and just outside its circumference, is a stationary scale marked in electrical degrees, and upon this the white line acts as a pointer, giving a direct reading of rotor displacement.

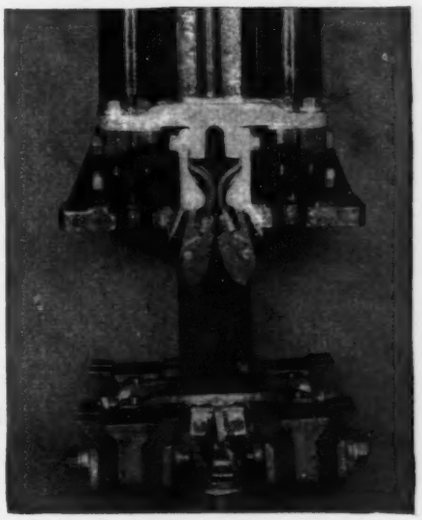
Stoker

Each section of the new Riley super-stoker made by the Riley Stoker Corporation, Worcester, Mass., is provided with a damper which is under the control of the operator so that he may supply more or less air, dependent on the fuel conditions at any particular point throughout the length of the stoker. These dampers are controlled from the side wall of the boiler. In the front wall construction means for admitting air over the top of the fuel bed has been provided and is under the control of the operator. The control consists of a sliding damper which is operated by a hand lever at the front of the stoker. Another improvement in the Riley super-stoker over the old design is in the grate block construction. A large diameter and long stroke plunger is used, the disadvantage of a large plunger being overcome by using four grate blocks at the front of the stoker of narrower width and then widening out the remaining grate blocks. This construction is said to give higher capacity and far greater pick-up and flexibility.

The clinker grinding operating mechanism has been redesigned to provide a more variable means of control. The drive for the double roll clinker grinder is so arranged that either or both rolls can be operated as desired. There is also a variable speed provision consisting of a cam which permits the driving pawl of the ratchet to engage one, two or three teeth as desired. The control for the ratchet pawl is independent for either grinder roll so that the speed of one roll can be varied independently of the other.

Heavy-Duty Oil Circuit Breaker for Indoor Service

The type "O-55" circuit breaker for generating station service, built in 4,000, 5,000 and 6,000 amp. capacities at 15,000 volts, with a rupturing capacity of 2,500,000 kva. at 15,000 volts, has been added to the line of the Westinghouse Electric & Manufacturing Company. The breaker units are mounted in a concrete structure with barriers between the units which are supported from the top plate that also carries the operating mechanism. This method of mounting places the barrier walls in compression, utilizing their maximum strength. The breaker is said to be of high mechanical strength. The condenser type terminals are used to pass



Detail of contacts on type O-55 heavy-duty oil circuit breaker

the conductors through the main base. The contacts are of parallel path construction. The arcing contacts protecting the main contacts are finger and wedge type, easily renewable and heavier than on lighter breakers to take care of increased rupturing capacity.

The electric mechanism consists of a double solenoid designed so that the pull of the closing mechanism closely matches the effort required to close the breaker units at all points of the closing stroke. This gives adequate speed of closing for synchronizing, and at the same time keeps down stresses within the structure. The electric mechanism is equipped with rotary type auxiliary switches for indicating, interlocking and control purposes. A control relay panel is also included in the closing mechanism. The control relay removes the energy from the electric mechanism immediately upon the completion of the closing stroke. The mechanism is mechanically full-automatic; that is, it cannot be held closed, either electrically or mechanically, if the tripping relays disengage the trigger.

Electrical Patents

Announced by U. S. Patent Office

(Issued March 6, 1928)

1,661,703. ELECTROLYTIC RECTIFIER; C. E. Ogden, Cincinnati, Ohio. App. filed Aug. 6, 1926.

1,661,712. ELECTRICAL APPLIANCE; P. Van Wagner, New York, N. Y. App. filed July 31, 1924. Ground cap for a tube or rod.

1,661,740. APPARATUS FOR EFFECTING ENERGIZATION CONTROL OF AN ELECTRIC CIRCUIT; E. R. Stoekle, Milwaukee, Wis. App. filed Aug. 13, 1921.

1,661,776. STORAGE-BATTERY CHARGE INDICATOR; T. J. Strouse, Pottstown, Pa. App. filed Aug. 13, 1926.

1,661,795. DOUBLE-THROW SWITCH; H. J. L. Frank, Detroit, Mich. App. filed Sept. 4, 1923. With interlocking cover.

1,661,823. INSULATOR; K. A. Hawley, New York, N. Y. App. filed June 4, 1921. Grading means for high tension insulators.

1,661,824. MOTOR-DRIVEN SEWING MACHINE; M. Hemleb, Elizabeth, N. J. App. filed May 19, 1925.

1,661,841. REGULATING SYSTEM; G. R. McDonald, Schenectady, N. Y. App. filed Aug. 30, 1926. For controlling the division of load between two sources of current.

1,661,842. ELECTRIC FURNACE; J. L. McFarland, Schenectady, N. Y. App. filed June 16, 1927. Means for supporting and securing the resistor.

1,661,850. ELECTRICAL SYSTEM; D. C. Prince, Schenectady, N. Y. App. filed May 18, 1925. An arrangement comprising an electron discharge device for interchanging power between direct and alternating current systems.

1,661,854. STORAGE-BATTERY DEVICE; F. C. Ridgely, Detroit, Mich. App. filed Feb. 20, 1925. For holding oil, grease, etc., under a battery post.

1,661,862. ELECTRIC HEATER; W. N. Vanatta, Ontario, Cal. App. filed Dec. 29, 1924. Means for protecting electric heaters from overheating.

1,661,883. ELECTRIC-SHIP-PROPULSION INSTALLATION; E. D. Dickinson, Lynn, Mass. App. filed July 19, 1922.

1,661,902. FEED-WIRE SUPPORT; N. A. Michaelson, Uniontown, Pa. App. filed May 27, 1927. Supporting device for feed wire of a trolley wire.

1,661,909. ELECTRIC CLOCK; C. E. Prince, Burchetts Green, England. App. filed Aug. 6, 1924.

1,661,913. BATTERY TESTER; J. Taylor, Chicago, Ill. App. filed Jan. 22, 1927.

1,661,923. ROTARY RECTIFIER; C. M. Clay, Mexico, Mo. App. filed June 2, 1923.

1,661,928. ELECTRIC LAMP; W. Dawson, London, England. App. filed May 23, 1927. Multiple filament type.

1,661,945. DRY CELL; W. F. Hendry, Ossining, N. Y. App. filed Jan. 23, 1924.

1,661,970. ELECTRIC WELDING MACHINE; F. L. Sessions, Lakewood, Ohio. App. filed Jan. 13, 1923. For welding longitudinal seams in thin wall drums or the like.

1,661,994. AUTOMATIC PORCH LIGHT; G. H. Brown, Nevada, Mo. App. filed Oct. 22, 1921.

1,662,027. TUNGSTEN PRODUCT AND ITS MANUFACTURE; A. de Graaff, Eindhoven, Netherlands. App. filed April 24, 1928. To prevent the sagging of a tungsten filament.

1,662,031. ELECTRICALLY HEATED DEVICE; F. H. McCormick, Glen Ellyn, Ill. App. filed Sept. 11, 1925. Such as ovens in which suitable mechanism is provided for automatic heat control.

1,662,045. LAMP-MAKING MACHINE; F. W. Patterson, Arlington, N. J. App. filed April 22, 1924.

(Issued March 13, 1928)

1,662,055. CONNECTING DEVICE; H. P. Chandler, Mansfield, Ohio. App. filed May 13, 1925. For making temporary connections to a conductor.

1,662,071. REGULATING SYSTEM; E. C. Manderfeld, Boonton, N. J. App. filed Aug. 4, 1926. To regulate mechanical or electrical characteristics, as for example, speed, frequency or voltage.

1,662,075. ELECTROLYTIC RECTIFIER; A. B. Muntyan, Amsterdam, Netherlands. App. filed Oct. 15, 1924.

1,662,083, 1,662,084, 1,662,085. ELECTRIC REGULATOR; H. M. Stoller, Mountain Lakes, N. J. Apps. filed Aug. 4, 1926. For regulating the speed or frequency of dynamo electric machines.

1,662,107. HIGH-TENSION ELECTRIC CABLE; L. Emanuell, Milan, Italy. App. filed Sept. 1, 1925. Of the type in which the strands of the conductor are supported by a hollow metallic core and through which oil flows and impregnates the insulation that surrounds the conductor.

1,662,114. FLASHING AND REGULATING APPARATUS FOR DISCHARGE TUBE DISPLAY; F. Hotchner, Los Angeles, Calif. App. filed March 9, 1927.

1,662,122. PRESSURE ACTUATED CIRCUIT CONTROL; I. E. McCabe, Chicago, Ill. App. filed Feb. 11, 1922.

1,662,132. INDUCTANCE APPARATUS; B. J. Simmons, Stillwater, Minn. App. filed Nov. 16, 1925. A compound electromagnetic cycle.

1,662,149. ELECTRIC-FURNACE VOLTAGE CONTROL; A. E. Greene, Medina, Wash. App. filed Jan. 3, 1913.

1,662,174. ELECTROMAGNETIC RELAY; E. W. Seeger, Milwaukee, Wis. App. filed May 17, 1920. Responsive to undulating currents.

1,662,233. TROLLEY WHEEL CARRIER; C. W. Brown, Los Angeles, Calif. App. filed Dec. 15, 1924.

1,662,243. CONTROLLER FOR ELECTRIC MOTORS; C. T. Evans, Milwaukee, Wis. App. filed May 8, 1922. For direct current motors.

1,662,245. YIELDABLE CONNECTER FOR ELECTRIC CABLES; C. M. Goodrich, Windsor, Ont., Can. App. filed June 14, 1927. For suspending high tension electric cables from the arms of towers and other overhead supports.

1,662,252. ELECTRIC REGULATOR; E. R. Morton, New York, N. Y. App. filed March 12, 1925. Electron tube regulator for electric generators.

1,662,275. SWITCH BOX; J. L. Lane, Chicago, Ill. App. filed May 19, 1924. With safety locking device.

1,662,334. STREET LIGHT FIXTURE; F. B. Reberg, Casper, Wyo. App. filed Nov. 24, 1924. Bracket suspension for streethood bodies for street lighting.

1,662,335. SPRING SOCKET TERMINAL; L. Reichold, Winsted, Conn. App. filed Nov. 26, 1926. For use with the quick detachable jack and plug connections for portable electrical utensils.

1,662,346. BATTERY TERMINAL CLAMP; R. B. Stewart, Crows Landing, Calif. App. filed Nov. 19, 1925.

1,662,349. STORAGE BATTERY; G. K. Thompson, Summit, N. J. App. filed Aug. 31, 1923.

1,662,366. AUTOMATIC ELECTRIC SERVICE SYSTEM; M. C. Cosgray, Sandusky, Ohio, App. filed April 23, 1923. An auxiliary source of supply of electric energy that will be automatically connected when the main supply falls below a predetermined amount.

1,662,369. ARC WELDING SYSTEM; J. Kjekstad, Brooklyn, N. Y. App. filed Aug. 1, 1918. Applicable to both carbon arc welding and to metallic arc welding.

1,662,383. ELECTROLYTIC RECTIFIER; W. H. Grimditch and J. N. Hunsberger, Jr., Philadelphia, Pa. App. filed Feb. 18, 1927.

1,662,434. CONTROL MECHANISM; M. W. Palmer, New York, N. Y. App. filed Jan. 4, 1927. Automatically operating controlling mechanism whereby the voltage in a line may be maintained within very close limits.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

An agency is desired in Santiago, Chile (No. 30,300), for storage batteries.

Purchase is desired in Panama City, Panama (No. 30,235), of electric dishwashers.

Purchase and agency are desired in Amsterdam, Netherlands (No. 30,236), for dishwashers, potato peelers, ice-cream freezers and other electric kitchen equipment for hotels, hospitals and steamships and electric refrigerators.

Purchase and agency are desired in Hamburg, Germany (No. 30,241), for electric laundry machinery.

An agency is desired in Barcelona, Spain (No. 30,254), for oil burners with motor and compressor.

New Trade Literature

MOTORS—"Lincoln 'Linc-Weld' Motors" is the title of a bulletin issued by the Lincoln Electric Company, Cleveland, in which it describes its "Linc-Weld" method of motor construction, showing in detail the use of welded steel. An illustration is given showing a phantom view of a standard Lincoln "Linc-Weld" motor. Attention is called to its automatic induction controller, the "Linc-Weld" switch-start motor, and the stable arc welder.

MOTORS, STARTERS AND TRANSFORMER RATIO ADJUSTERS.—The General Electric Company, Schenectady, N. Y., is distributing bulletins GEA-808A, GEA-137A, GEA-467A and GEA-147B, describing and illustrating respectively its forms RA and RL totally inclosed fan-cooled induction motors "500 series," types TS and QS "6000 series" synchronous motors for mounting on compressor shafts, CR7022 automatic starters for slip-ring motors and power transformer ratio adjusters.

WATT-HOUR METER. — The Sangamo Electric Company, Springfield, Ill., has issued a bulletin in which it describes and illustrates the Sangamo type HC watt-hour meter. Illustrations show the construction of this new meter. Included is a table of train ratios and disk constants and a series of curves showing the meter accuracy with change in load, change in temperature, change in voltage and change in frequency.

ELECTRIC RANGES AND PANELBOARDS.—The Benjamin Electric Manufacturing Company, 120 South Sangamon Street, Chicago, has issued catalog No. 302A, covering its new "Consolette" electric ranges. Illustrations showing the various types of the ranges are given and a description of the construction of the "Consolette" range is included. The company also is distributing a bulletin on the "Little Sentry" line of panelboards with or without arrangements for branch circuit tumbler switches, recommended for residences, apartment buildings, schools, small stores and factories and similar places having from four to twelve branch circuits.

RAILWAY EQUIPMENT. — Bulletins GEA-797, GEA-872, GEA-921 and GEA-951 issued by the General Electric Company, Schenectady, N. Y., describe and illustrate respectively the repair of commutators of railway and industrial-haulage motors, drum type controllers for railway service, better lubrication for G-E 265 railway motors and the "Mazda" C short-circuiting lamp and socket for 600-volt railway circuits.

METER RECORDS.—"What Can You Do in Fifteen Seconds" is the title of a catalog issued by the Kardex division of the Remington Rand Business Service, Inc., 374 Broadway, New York City, covering its meter record system. How the Erie County Electric Company applies the method to its system is described. Attention is called to the fact that the record is not only a meter record but also serves as an address record and a test record. A complete description of the system is included and a sample of the cards used are attached to the catalog.

NEON TUBES AND ACCESSORIES.—The New Jersey Neon Light & Power Corporation, Camden, N. J., has issued a catalog covering "Neon" tubes and "Neon" accessories for sign work.

POLE LINE MATERIAL — A catalog issued by the Oliver Iron & Steel Corporation, South Tenth and Muriel Streets, Pittsburgh, Pa., covers a condensed listing of Oliver pole line hardware and construction specialties. The various products listed are all illustrated and described.

CABLE RACKS AND SWITCHES.—The Metropolitan Device Corporation, 1250 Atlantic Avenue, Brooklyn, N. Y., is distributing a bulletin in which it describes and illustrates its cable racks for manhole, vault, station wall and service box mounting, and other underground distribution devices. Photographs show some special cable vault installations. The company has also issued a pamphlet covering meter service switches, the accessible main fuse type with testing facilities and accessible branch fuses combined.

RECORDING INSTRUMENTS AND LIMIT SWITCH. — Bulletin GEA-927 issued by the General Electric Company, Schenectady, N. Y., covers its type CP-4 and CP-5 alternating-current portable recording instruments. The company is also distributing bulletin GEA-914, describing the CR9441-LS424A limit switch for use on control circuits only.